GROUP 11D

ENGINE OVERHAUL <4G1>

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GENERAL INFORMATION

M1113000101065

VEHICLE AND ENGINE MODELS

Vehicle name	Vehicle model	Engine model	Displacement cc	Specification
Colt	Z27A	4G15-7	1,468	Double overhead camshaft (DOHC), 16-valve, V.V.T.

GENERAL SPECIFICATIONS

M1113000200973

Item		Specification
Total displacement mL		1,468
Bore × Stroke mm		75.5 × 82.0
Compression ratio		9.0
Compression chamber		Pentroof
Camshaft arrangement		DOHC
Number of valve	Intake	2
	Exhaust	2
Valve timing	Intake opening	BTDC 34° – ATDC 6°
	Intake closing	ABDC 30° – ABDC 70°
	Exhaust opening	BBDC 50°
	Exhaust closing	ATDC 10°
Fuel system		Electronically controlled multipoint fuel injection
Rocker arm		Roller type
Auto-lash adjuster		Equipped

SERVICE SPECIFICATIONS

M1113000301025

Item		Standard value	Limit
TIMING BELT			
Auto-tensioner rod extension length (with timing belt installed) mm		4.8 – 5.5	–
Auto-tensioner rod extension length (when free) mm		12.0	–
Auto-tensioner rod retraction length (when pressed with force of 98 – 196 N·m) mm		Less than 1	–
ROCKER ARMS AND CAMSHAFTS			
Cam height mm	Intake valves	35.08	34.58
	Exhaust valves	34.26	33.76

Item		Standard value	Limit
CYLINDER HEAD AND VALVES			
Cylinder head gasket surface warp mm		0.03	0.2
Cylinder head gasket surface grinding limit (including cylinder block grinding amount) mm		–	0.2
Cylinder head overall height mm		131.9 – 132.1	–
Valve margin mm	Intake valves	1.0	0.5
	Exhaust valves	1.5	1.0
Valve length mm	Intake valves	106.35	105.85
	Exhaust valves	106.85	106.35
Valve spring free height mm		54.8	55.8
Valve spring squareness		2° or less	4°
Valve stem-to-guide clearance mm	Intake valves	0.02 – 0.05	0.10
	Exhaust valves	0.03 – 0.06	0.15
Valve guide length mm	Intake valves	48	–
	Exhaust valves	55	–
Valve guide projection mm		22.7 – 23.3	–
Valve face-to-seat contact width mm		0.9 – 1.3	–
Valve projection from valve spring seat mm	Intake valves	48.8	49.3
	Exhaust valves	48.7	49.2
OIL PUMP AND OIL PAN			
Oil pump tip clearance mm		0.06 – 0.18	–
Oil pump side clearance mm		0.10 – 0.18	–
Oil pump body clearance mm		0.040 – 0.095	–
PISTONS AND CONNECTING RODS			
Piston pin press-in load (at ambient temperature) N		4,900 – 14,700	–
Piston ring side clearance in ring groove mm	No. 1	0.03 – 0.07	0.1
	No. 2	0.02 – 0.06	0.1
Piston ring end gap mm	No. 1	0.15 – 0.30	0.8
	No. 2	0.30 – 0.45	0.8
	Oil ring	0.20 – 0.50	1.0
Connecting rod big end thrust clearance mm		0.10 – 0.25	0.4
Oil clearance at crankshaft pins mm		0.025 – 0.040	0.1
CRANKSHAFT AND CYLINDER BLOCK			
Crankshaft end play mm		0.05 – 0.18	0.25
Oil clearance at crankshaft journals mm		0.02 – 0.04	0.1
Cylinder block gasket surface warp mm		0.05	0.1
Cylinder block gasket surface grinding limit (including cylinder head grinding amount) mm		–	0.2

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Item	Standard value	Limit
Cylinder bore diameter mm	75.50 – 75.53	–
Taper of cylinder mm	0.01 or less	–
Cylinder-to-piston clearance mm	0.02 – 0.04	–

REWORK DIMENSIONS

M1113024300480

Item	Standard value	Standard value
CYLINDER HEAD AND VALVES		
Cylinder head oversize valve guide hole diameter mm	0.05 O.S.	10.55 – 10.57
	0.25 O.S.	10.75 – 10.77
	0.50 O.S.	11.00 – 11.02
Cylinder head oversize valve seat hole diameter, intake mm	0.30 O.S.	31.30 – 31.33
	0.60 O.S.	31.60 – 31.63
Cylinder head oversize valve seat hole diameter, exhaust mm	0.30 O.S.	27.80 – 27.82
	0.60 O.S.	28.10 – 28.12

TORQUE SPECIFICATIONS

M1113023401777

Item	N·m
ALTERNATOR AND IGNITION SYSTEM	
Oil level gauge guide bolt	24 ± 4
Water pump pulley bolts	9.0 ± 2.0
Crankshaft bolts	181
Alternator brace bolt (alternator side)	22.5 ± 2.5
Alternator brace bolt (tightened with water pump)	24 ± 3
Alternator nut	44 ± 10
Adjusting bolt	5.0 ± 1.0
Ignition coil bolts	10 ± 2
Spark plug	25 ± 5
Cam position sensor bolt	8.8 ± 1.0
Cam position sensor support bolts	14 ± 1
TIMING BELT	
Timing belt cover bolts	11 ± 1
Rocker cover bolts	5.0 ± 1.0 → 7.0 ± 1.0
Plug cap	21 ± 3
Tensioner pulley bolt	48 ± 6

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Item	N·m
Tensioner arm bolt	48 ± 6
Auto-tensioner bolts	23 ± 3
Idler pulley bolt	44 ± 10
Crank angle sensor bolts	9.8 ± 2.0
V.V.T. sprocket bolt	55 ± 5
Camshaft sprocket bolt	88 ± 10
Engine support bracket bolts, nut	36 ± 6
FUEL AND EMISSION PARTS	
Throttle body bolts	13 ± 2
Solenoid valve bolts	9.0 ± 1.0
Purge valve bolts	5.0 ± 1.0
Delivery pipe and injector bolts	12 ± 1
Fuel pressure regulator bolts	12 ± 1
Vacuum pipe bolts	9.0 ± 1.0
Solenoid valve nut	5.0 ± 1.0
WATER PUMP AND WATER HOSE	
Engine coolant temperature sensor	29 ± 10
Water inlet fitting bolts	22 ± 4
Water pipe bolts (M6)	10 ± 2
Water pipe bolt s(M8)	13 ± 2
Water inlet pipe bolts	13 ± 2
Water pump bolts	14 ± 1
INLET MANIFOLD	
Inlet manifold stay bolts (M8)	18 ± 2
Inlet manifold stay bolts (M10)	31 ± 3
Inlet manifold bolts and nuts	18 ± 2
Engine hanger bolt	19 ± 3
EXHAUST MANIFOLD	
Oxygen sensor	50 ± 10
Turbocharger cover bolts	10 ± 2
Oil return pipe bolts	10 ± 2
Exhaust fitting bracket bolts	35 ± 6
Exhaust fitting bolts	59 ± 5
Turbocharger bracket bolts (turbocharger side)	59 ± 5
Turbocharger bracket bolts (cylinder block side)	35 ± 6
Oil pipe bolt (flange bolt)	10 ± 2
Oil pipe bolt (eye bolt)	17 ± 2
Turbocharger bolts, nuts	59 ± 5
Water pipe bolt (eye bolt)	31 ± 2
Water pipe bolt (flange bolt)	10 ± 2

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Item	N·m
Exhaust manifold nuts (M8)	29 ± 3
Exhaust manifold nuts (M10)	49 ± 5
Thermostat housing hanger bolt	24 ± 4
Engine hanger bolt	19 ± 3
ROCKER ARMS AND CAMSHAFT	
Oil feeder control valve bolt	11 ± 1
Oil pipe eye-bolt (cylinder block side)	30 ± 3
Oil pipe eye-bolt (cylinder head side)	42 ± 2
Cam position sensing cylinder bolt	22 ± 4
Front bearing cap bolt	21 ± 2
Rear bearing cap bolts	21 ± 2
Bearing cap bolts	11 ± 1
CYLINDER HEAD AND VALVES	
Cylinder head bolts	49 → 0 → 20 → +90° +90°
OIL PUMP AND OIL PAN	
Oil cooler bolt	27 ± 2
Oil pressure switch	10 ± 2
Drain plug	39 ± 5
Oil pan bolts	7.0 ± 1.0
Transmission stay bolts	23 ± 4
Oil screen bolts	19 ± 3
Baffle plate bolts	10 ± 2
Relief plug	44 ± 5
Oil pump case bolts	14 ± 1
Oil pump cover bolts	10 ± 2
PISTONS AND CONNECTING RODS	
Connecting rod cap nuts	17 ± 2 → +90° to 94°
CRANKSHAFT AND CYLINDER BLOCK	
Flywheel bolts	132 ± 5
Rear plate bolts	10 ± 2
Oil seal case bolts	11 ± 1
Bearing cap bolts	34 ± 2 → +30° to 34°
Detonation sensor bolts	20 ± 1

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SEALANTS

M1113000500899

Item	Specified sealant
Camshaft position sensor support*	Mitsubishi Genuine Part No. 970389 or equivalent
Rocker cover*	Mitsubishi Genuine Part No. 970389 or equivalent
Engine coolant temperature sensor	3M Nut Locking Part No.4171 or equivalent
Cylinder head (camshaft bearing cap fitting section)	3M ATD No.8660 or equivalent
Oil pan*	Mitsubishi Genuine Part No. 970389 or equivalent
Oil pump case*	Mitsubishi Genuine Part No. 970389 or equivalent
Oil pressure switch	3M ATD No.8660 or equivalent
Rear oil seal case*	Mitsubishi Genuine Part No. 970389 or equivalent

*NOTE: *: Part to be sealed with a form-in-place gasket (FIPG)*

FORM-IN-PLACE GASKET (FIPG)

This engine has several areas where the form-in-place gasket (FIPG) is used for sealing. To ensure that the FIPG fully serves its purpose, it is necessary to observe some precautions when applying it.

Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of fluid passages. To prevent leaks or blocking of passages, therefore, it is absolutely necessary to apply the FIPG evenly without a break, while observing the correct bead size.

FIPG hardens as it reacts with the moisture in the atmospheric air, and it is usually used for sealing metallic flange areas.

Disassembly

Parts sealed with a FIPG can be easily removed without need for the use of a special method. In some cases, however, the FIPG in joints may have to be broken by tapping parts with a mallet or similar tool.

Surface Preparation

Thoroughly remove all substances deposited on the FIPG application surface, using a gasket scraper. Make sure that the FIPG application surface is flat and smooth. Also make sure that the surface is free from oils, greases and foreign substances. Do not fail to remove old FIPG that may remain in the fastener fitting holes.

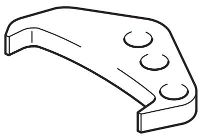
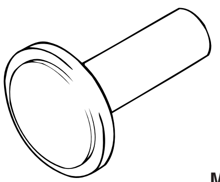
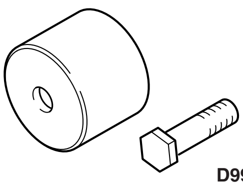
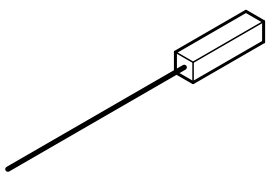
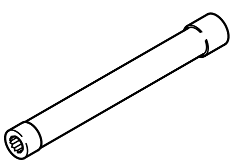
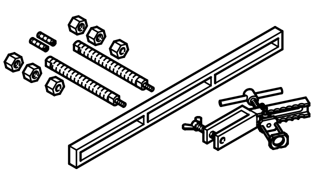
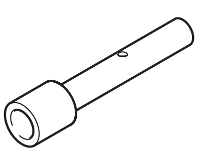
FIPG Application

Applied FIPG bead should be of the specified size and free of any break. FIPG can be wiped away unless it has completely hardened. Install the mating parts in position while the FIPG is still wet (in less than 15 minutes after application). Do not allow FIPG to spread beyond the sealing areas during installation. Avoid operating the engine or letting oils or water come in contact with the sealed area before a time sufficient for FIPG to harden (approximately one hour) has passed. FIPG application method may vary from location to location. Follow the instruction for each particular case described later in this manual.

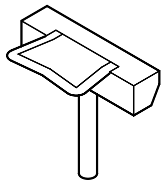
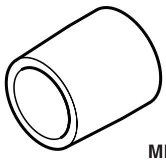
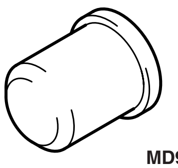
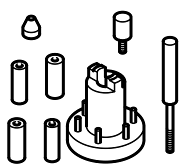
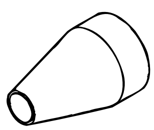
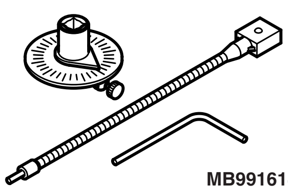
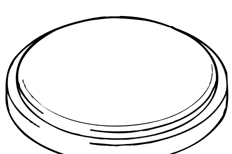
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SPECIAL TOOLS

M1113000601617

Tool	Number	Name	Use
 MB991883	MB991883	Flywheel stopper	Retention of flywheel
 MD998762	MD998762	Circular packing installer	Installing of circular packing
 D998713	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998442	Air bleed wire	Air bleeding of lash adjuster
	MB991653	Cylinder head bolt wrench	Removal and installation of cylinder head bolts
	MD998772	Valve spring compressor	Compression of valve spring
 B991671	MB991671	Valve stem seal installer	Installation of valve stem seal

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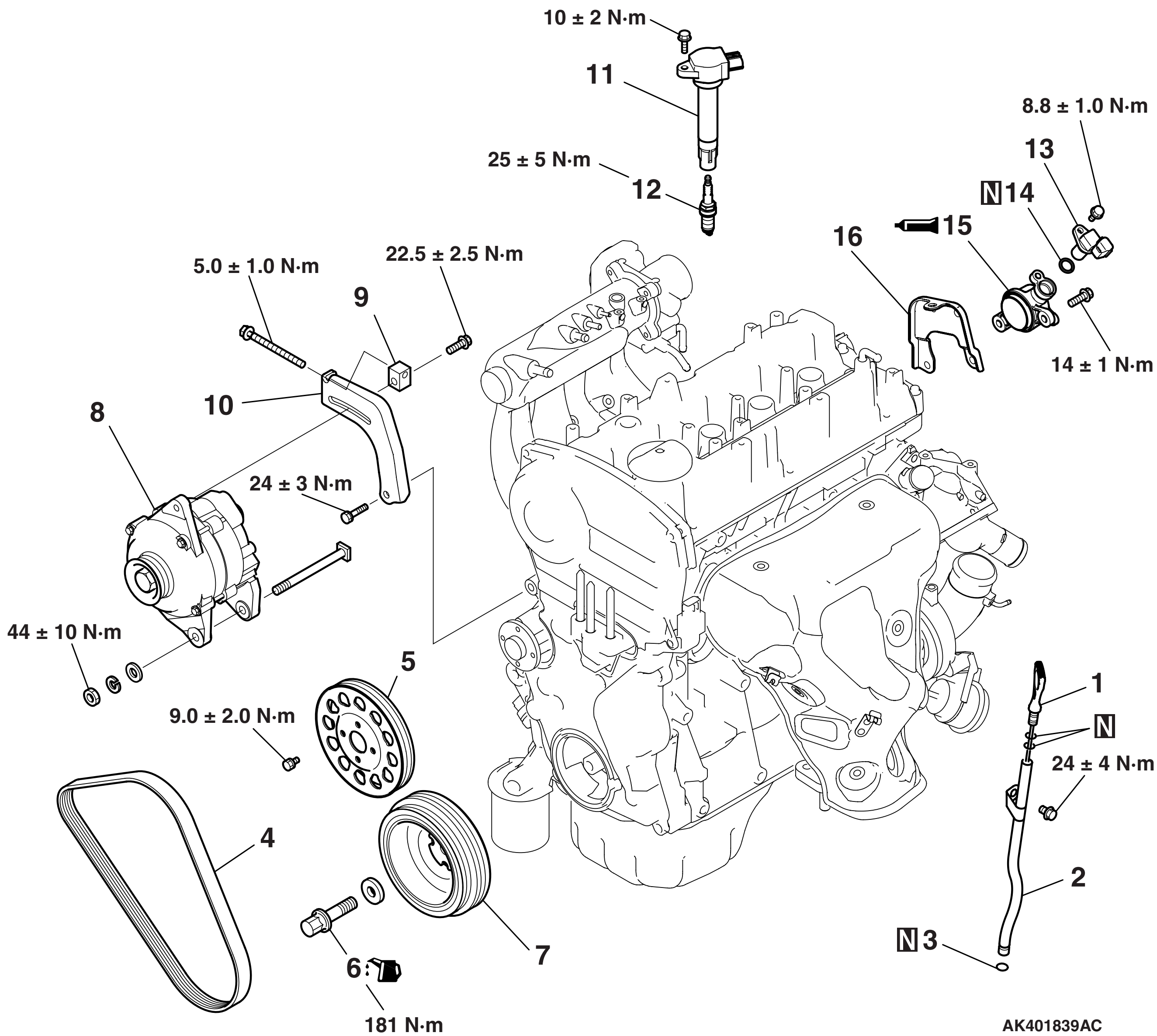
Tool	Number	Name	Use
 D998727	MD998727	Oil pan remover	Removal of oil pan
 MB991962	MB991962	Crankshaft front oil seal guide	Installation of crankshaft front oil seal (used with MD998306)
 MD998306	MD998306	Camshaft oil seal installer	Installation of crankshaft front oil seal (used with MB991962)
	MD998780	Piston pin setting tool	Removal and press-fitting of piston pin (used with MB991659)
	MB991659	Guide D	Guide for removal of piston pins (used with MD998780)
 MB991614	MB991614	Angle gauge	Installation of crankshaft bearing caps
 MD998011	MD998011	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal

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ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001001298



Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Drive belt
5. Water pump pulley

<<**A**>> >>**B**<< 6. Crankshaft bolt

7. Crankshaft pulley
8. Alternator
9. Adjust nut

Removal steps (Continued)

10. Alternator brace
11. Ignition coil
12. Spark plug
13. Cam position sensor
14. O-ring

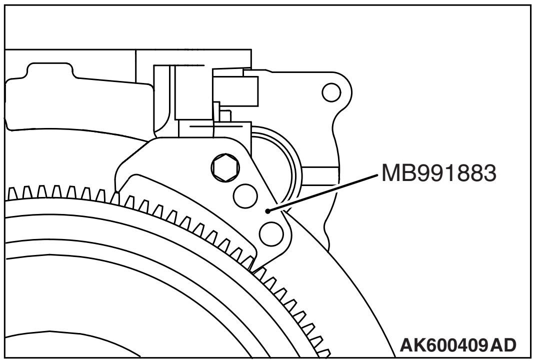
>>**A**<< 15. Cam position sensor support

16. Air intake pipe bracket

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REMOVAL SERVICE POINT

<<A>> CRANKSHAFT BOLT REMOVAL

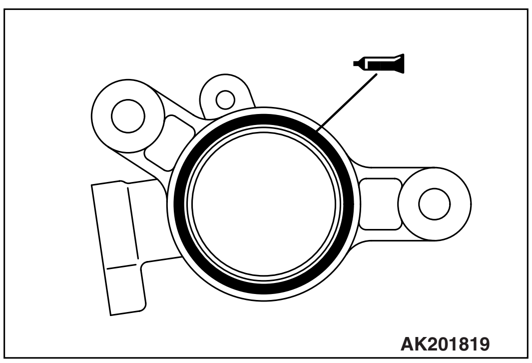


AK600409AD

1. Lock the flywheel using the special tool Flywheel stopper (MB991883).
2. Then loosen the crankshaft bolts.

INSTALLATION SERVICE POINTS

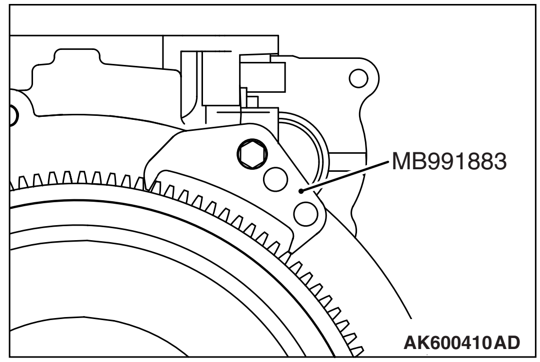
>>A<< CAM POSITION SENSOR SUPPORT INSTALLATION


AK201819

1. Completely remove existing form-in-place gasket from the cam position sensor support and cylinder head (surface to which cam position sensor support is fitted).
2. Apply a 3 ± 1 mm bead of form-in-place gasket (FIPG) to the area shown.

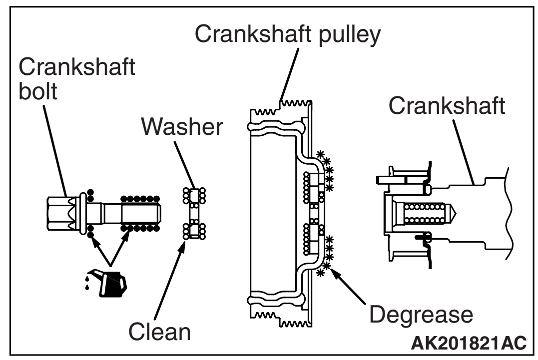
   Specified sealant:
   Mitsubishi Genuine Part No.970389 or equivalent
3. With the tightening bolt, tighten the cam position sensor support and the air intake pipe bracket assembly together with the cylinder head to the specified torque of 14 ± 1 N·m.

>>B<< CRANKSHAFT BOLT INSTALLATION



AK600410AD

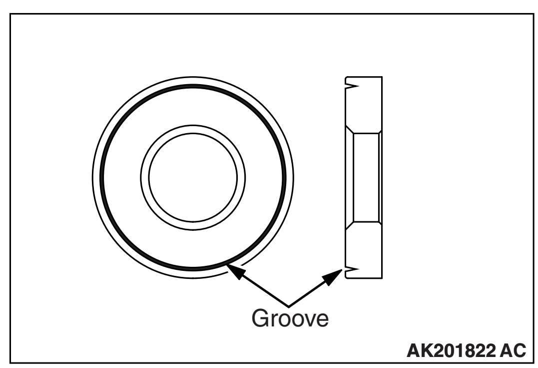
1. Lock the flywheel using the special tool Flywheel stopper (MB991883).



AK201821AC

2. Clean the bolt hole in crankshaft.
3. Clean and degrease the crankshaft pulley.

   NOTE: Degreasing is necessary to prevent decrease in friction between of the mating surfaces due to the presence of oil.
4. Install the crankshaft pulley.
5. Apply a proper minimum quantity of engine oil to the threads of crankshaft and the lower part of flange.



AK201822AC

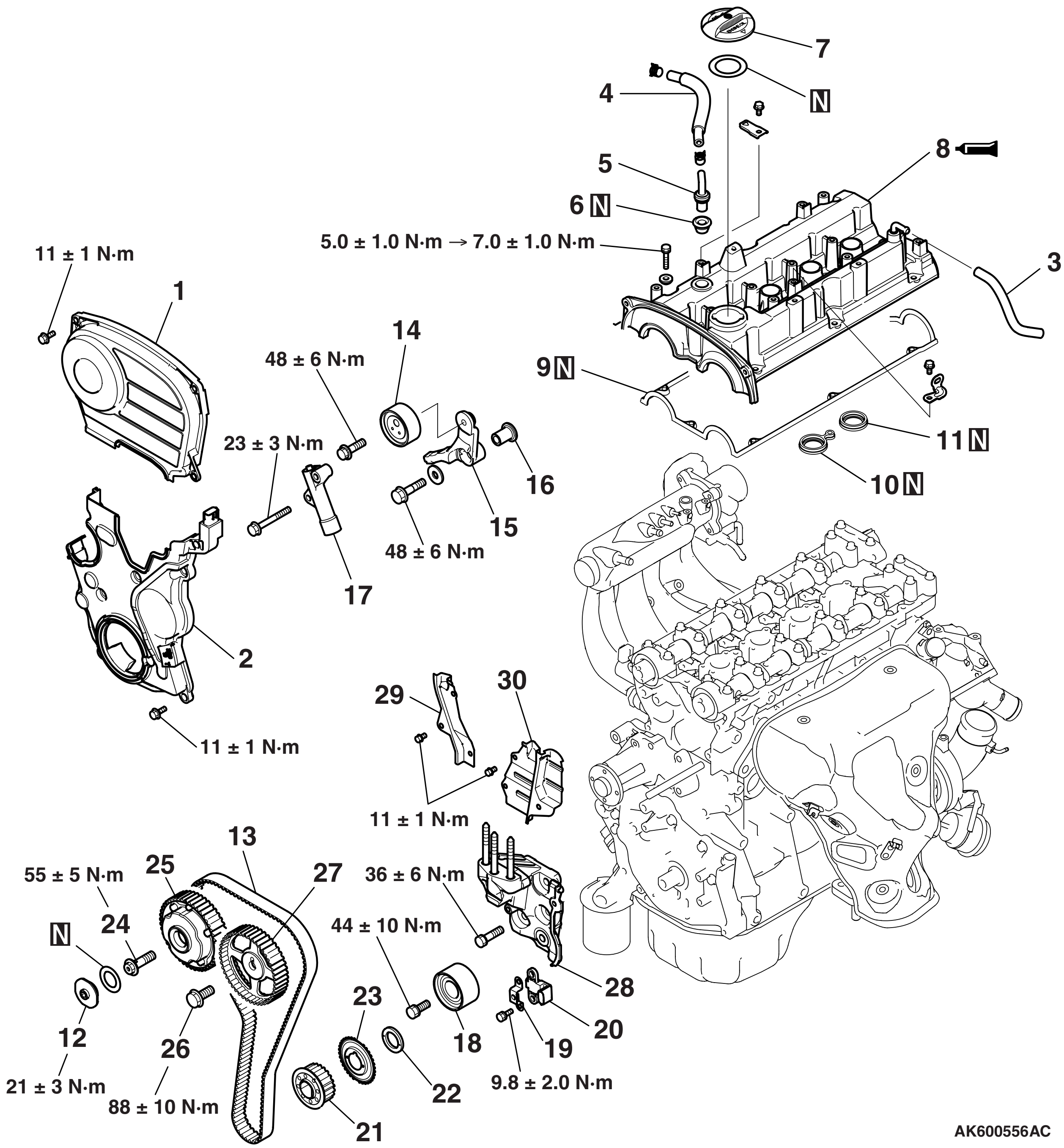
6. Install the washer, whose grooved surface is toward the bolt flange.
7. Tighten the crankshaft bolt to the specified torque of 181 N·m.

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TIMING BELT

REMOVAL AND INSTALLATION

M1113001901387



AK600556AC

Removal steps

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Breather hose
4. PCV hose
5. PCV valve
6. PCV valve gasket
7. Oil filler cap
8. >>**H**<< Rocker cover
9. Rocker cover gasket A
10. Rocker cover gasket B

Removal steps (Continued)

11. Rocker cover gasket C
12. <<**A**>> >>**G**<< Plug cap
13. <<**B**>> >>**F**<< Timing belt
14. >>**E**<< Tensioner pulley
15. Tensioner arm
16. Shaft
17. >>**D**<< Auto-tensioner
18. Idler pulley
19. Bracket
20. Crank angle sensor

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Removal steps (Continued)

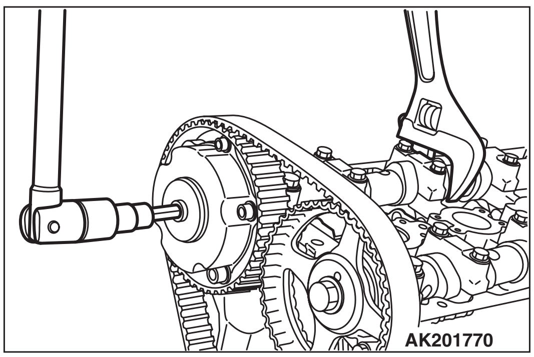
	>>**C**<<	21.	Crankshaft sprocket
	>>**C**<<	22.	Spacer
	>>**C**<<	23.	Sensing blade
<<**C**>>	>>**B**<<	24.	V.V.T. sprocket bolt
	>>**B**<<	25.	V.V.T. sprocket
<<**D**>>	>>**A**<<	26.	Camshaft sprocket bolt
		27.	Camshaft sprocket
		28.	Engine support bracket
		29.	Timing belt rear cover, right
		30.	Timing belt rear cover, left

⚠ CAUTION

Never disassemble the V.V.T. sprocket.

REMOVAL SERVICE POINTS

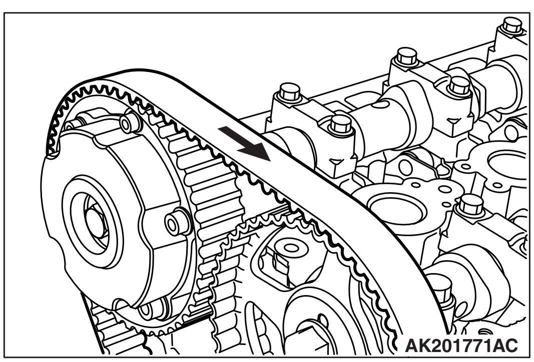
<<A>> PLUG CAP REMOVAL



Remove the plug cap using a wrench fitted on the hexagonal portion of the camshaft.

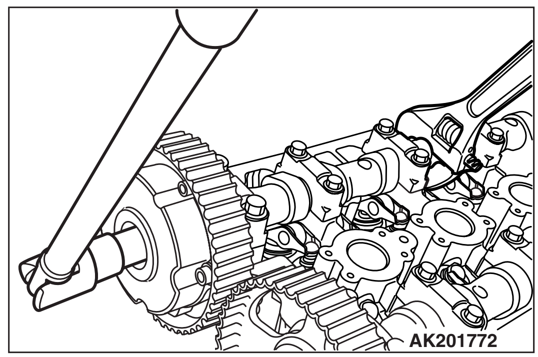
<<B>> TIMING BELT REMOVAL

1. By turning the crankshaft, position the No.1 cylinder at the Top Dead Center of the compression stroke.



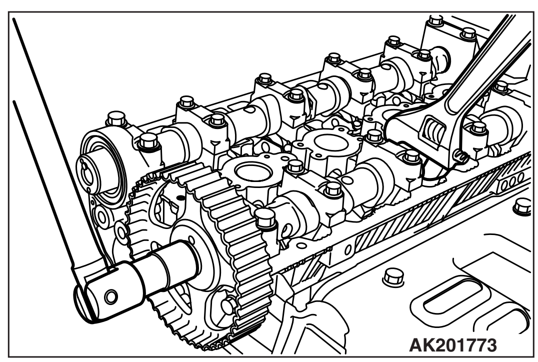
2. If the timing belt is to be reused, it is necessary to install it in the same direction as it was before. Mark an arrow that shows the direction of rotation on the back surface of the timing belt with chalk, etc.

<<C>> V.V.T. SPROCKET BOLT REMOVAL



Remove the V.V.T. sprocket bolt using a wrench fitted on the hexagonal portion of the camshaft.

<<D>> CAMSHAFT SPROCKET BOLT REMOVAL

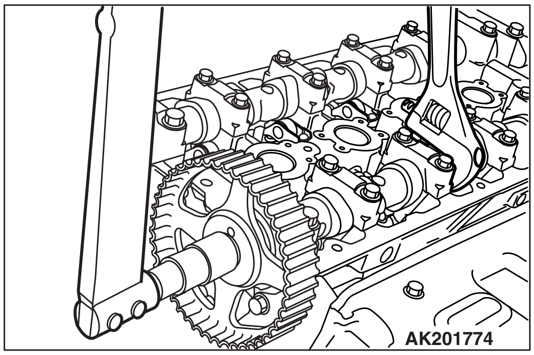


Remove the camshaft sprocket bolt using a wrench fitted on the hexagonal portion of the camshaft.

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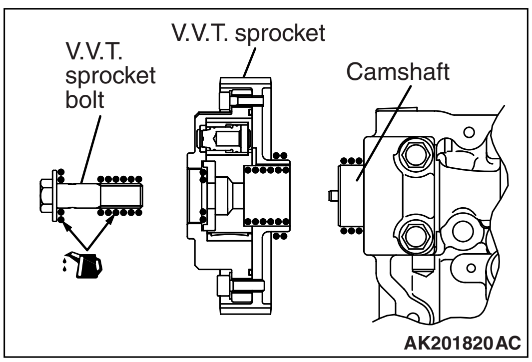
INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT SPROCKET BOLT INSTALLATION

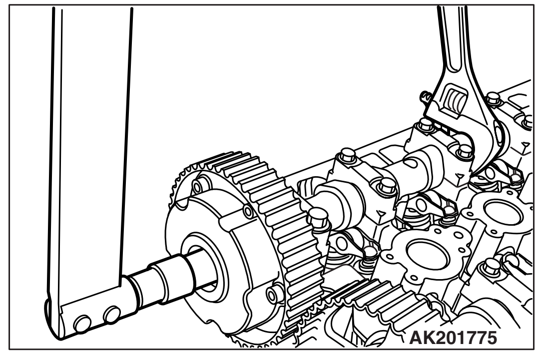


Tighten the camshaft sprocket bolt to 88 ± 10 N·m while preventing the camshaft from rotation using a wrench fitted on the hexagonal portion of the camshaft.

>>B<< V.V.T. SPROCKET BOLT/V.V.T. SPROCKET INSTALLATION



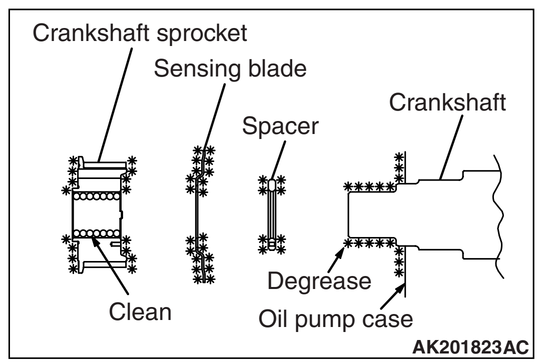
1. Apply a proper minimum quantity of engine oil to the following points.
   - Camshaft end
   - Insertion hole in V.V.T. sprocket (all over inside and outside surfaces)
   - Threads and head of V.V.T. sprocket bolt
   - Bearing surface of V.V.T. sprocket bolt
2. Install the V.V.T. sprocket onto the camshaft.
3. Make sure that the V.V.T. sprocket is installed all the way onto the camshaft. Holding the hexagonal portion of the camshaft with a wrench, check that the V.V.T. sprocket does not turn.



4. Holding the hexagonal portion of the camshaft with a wrench, tighten the V.V.T. sprocket bolt to a specified torque of 55 ± 5 N·m.
5. Holding the hexagonal portion of the camshaft with a wrench, check that the V.V.T. sprocket is not loose to turn.

   NOTE: This check is to ascertain that the V.V.T. sprocket is locked at the most retarding position by means of internal pin.

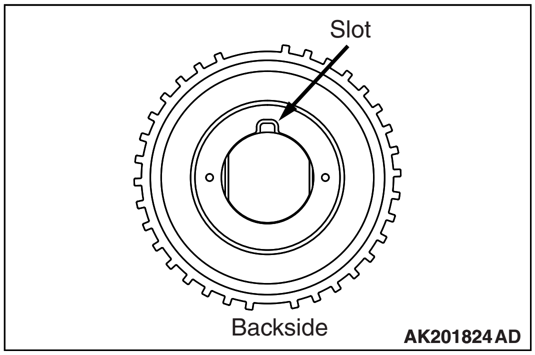
>>C<< CRANKSHAFT SPROCKET/SPACER/SENSING BLADE INSTALLATION



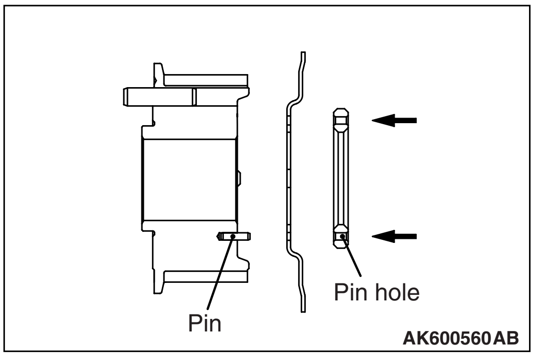
1. Clean the hole in the crankshaft sprocket.
2. Clean and degrease the mating surfaces of the crankshaft sprocket and spacer; sensing blade; crankshaft sprocket; and oil pump case.

   NOTE: Degreasing is necessary to prevent decrease in friction between the mating surfaces due to presence of oil.

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3. Assemble the crankshaft sprocket and sensing blade, projection to slot, as shown.



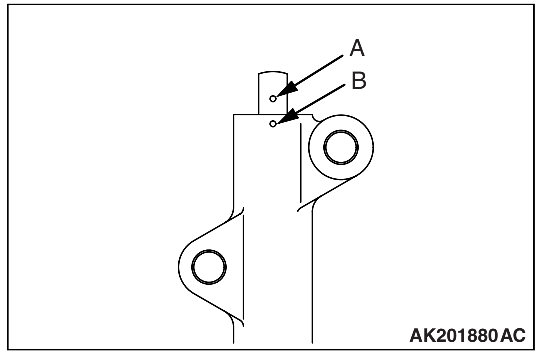
4. Align the pins to the pin holes and apply even pressure in the arrow direction.

⚠ CAUTION

When installing the sprocket, do not bend the sensing blade.

5. Install the crankshaft sprocket onto the crankshaft.

>>D<< AUTO-TENSIONER INSTALLATION

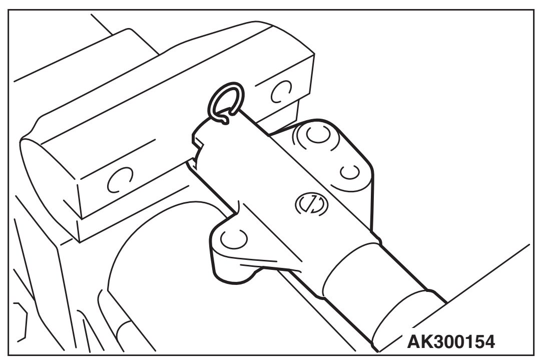


1. If the auto-tensioner rod remains in its fully extended position, reset it to the retracted position as follows:
   (1) Clamp the auto-tensioner in a vise at right angles to the jaws.

⚠ CAUTION

Because the leak down of the auto-tensioner takes a long time, slowly insert the rod. If the rod is suddenly inserted, the auto-tensioner could be damaged.

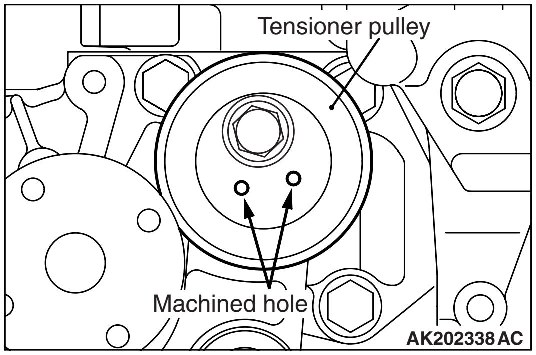
   (2) Push in the rod little by little with the vise until the set hole A in the rod is aligned with the set hole B in the cylinder.



   (3) Insert a piece of wire (1.4 mm diameter) into the set holes.
   (4) Remove the auto-tensioner from the vise.
2. Install the auto-tensioner in position. Leave the wire installed until the auto-tensioner is completely installed.

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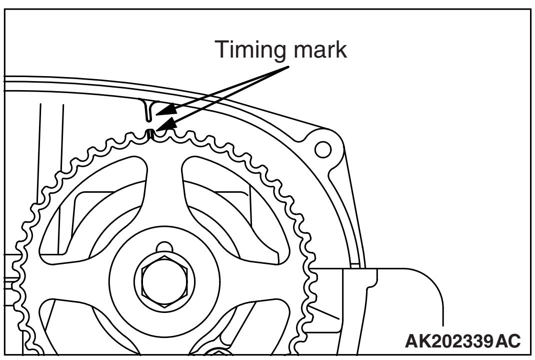
>>E<< TENSIONER PULLEY INSTALLATION



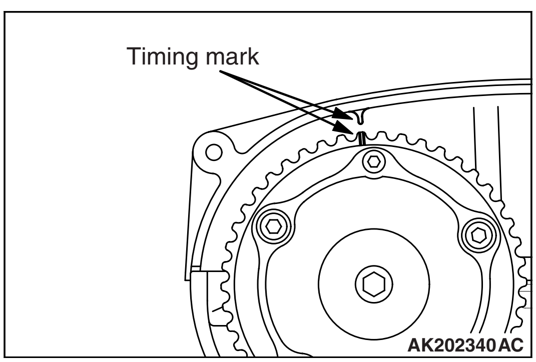
Install the tensioner pulley onto the tensioner arm, with the machined holes facing in front as shown.

>>F<< TIMING BELT INSTALLATION

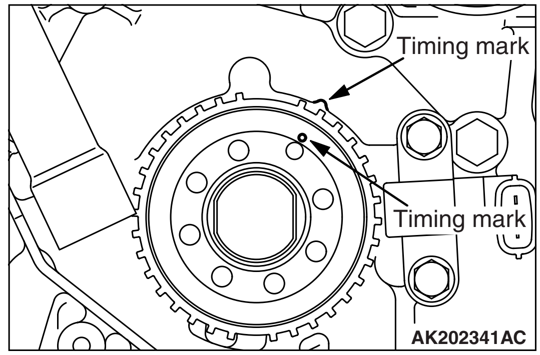
1. For aligning the timing marks on the camshaft sprocket and V.V.T. sprocket, install the rocker cover temporarily.



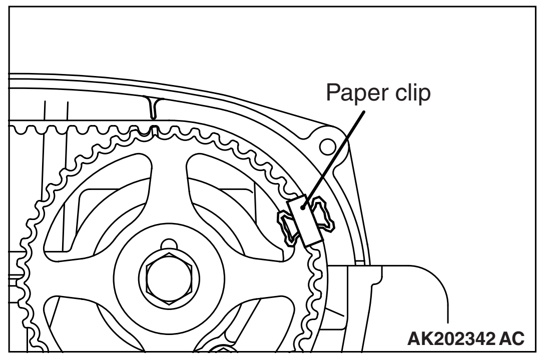
2. Align the timing mark on the camshaft sprocket.



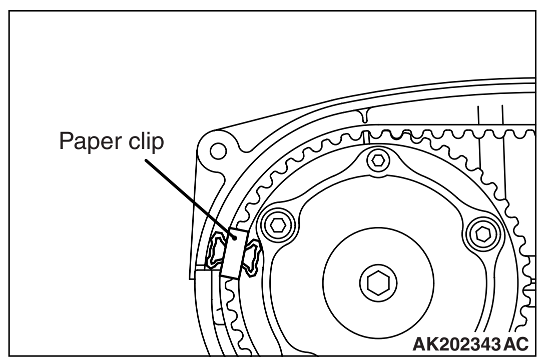
3. Align the timing mark on the V.V.T. sprocket.



4. Align the timing mark on the crankshaft sprocket.
5. First fit the timing belt onto the crankshaft sprocket.
6. Fit the timing belt onto the idler pulley.

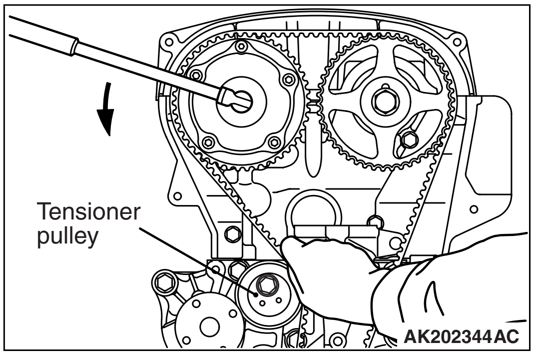


7. Fit the timing belt onto the camshaft sprocket, and bind it with paper clip in the illustrated shown in the illustration.



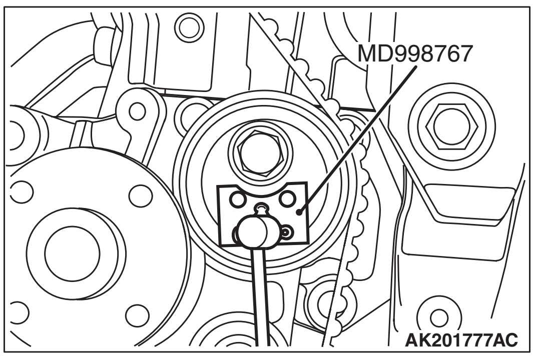
8. Fit the timing belt onto the V.V.T. sprocket, and bind it with paper clip in the position shown in the illustration.

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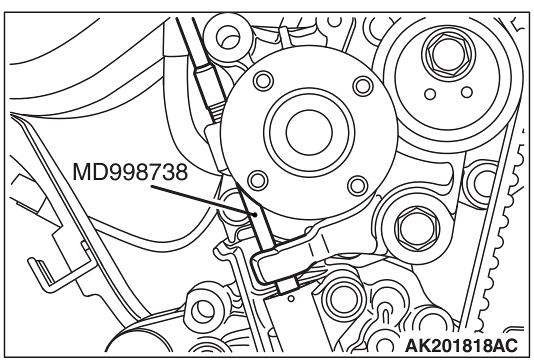


9. Fit the timing belt onto the tensioner pulley.

   NOTE: To make belt installation easier, turn the V.V.T. sprocket a little counter-clockwise.



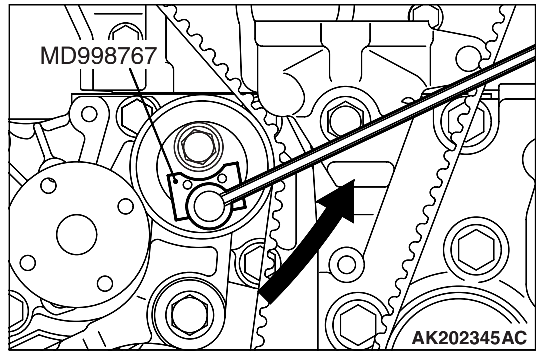
10. Using the special tool of tensioner pulley socket (MD998767), apply the tension to the timing belt by turning the tensioner pulley counterclockwise, then temporally tighten the fixing bolt of the tensioner pulley and fix the tensioner pulley firmly.
11. Turn the crankshaft a quarter turn counter-clockwise, then turn it clockwise to align the timing marks.



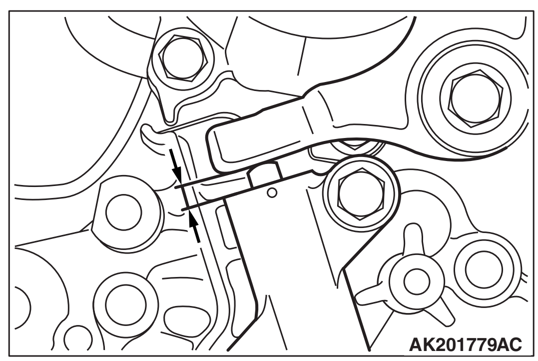
12. Install the special tool Set screw (MD998738) in position and drive it in to such an extent that the wire inserted when the auto tensioner was installed lightly moves.

⚠ CAUTION

The timing belt is loosened with the rotation of the intake and exhaust camshafts. Take care that the timing belt does not slip out of place.



13. Loosen the lock bolt holding the tensioner pulley.
14. Turn the torque wrench attached to the special tool Tensioner pulley socket (MD998767) counter-clockwise until the slack in the timing belt is taken up.
15. Torque to 0.8 N·m with the torque wrench.
16. Check that all the timing marks are in alignment.
17. Remove the special tool Set screw (MD998738) installed at step 12.
18. Give the crankshaft two turns clockwise, and leave it in that state for approximately 15 minutes.



19. Check to see if the wire inserted when the auto tensioner was installed can be easily pulled out. If so, the belt tension is optimal and the wire may be removed. Alternatively, if the protrusion of the auto tensioner rod is within the specified range of standard values, the belt tension is optimal.

    Standard value: 4.8 − 5.5 mm

⚠ CAUTION

When the crankshaft bolt was turned counter-clockwise, be sure to check its tightening torque. If the bolt is loose, retighten it.

20. If the wire cannot be easily removed, repeat the steps from 12 to 18 above for proper tension of the belt.
21. Finally, remove the temporarily installed rocker cover.

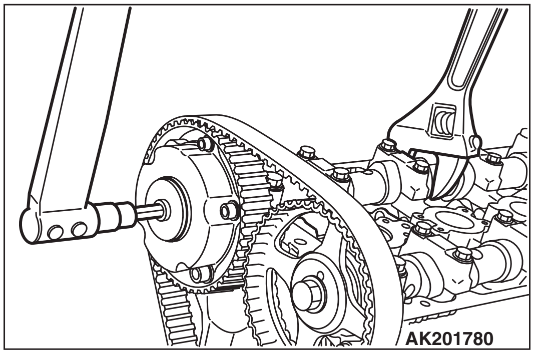
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>>G<< PLUG CAP INSTALLATION

⚠ CAUTION

Do not reuse washer.

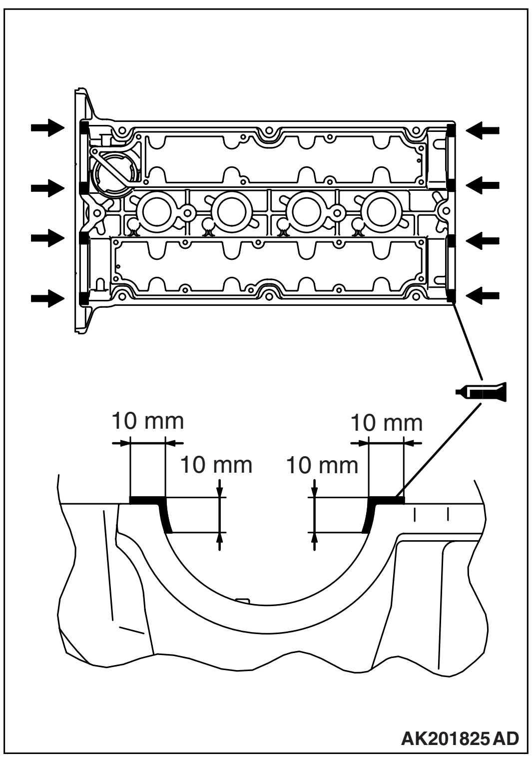
1. Replace washer on the plug cap.



2. Holding the hexagonal portion of the camshaft with a wrench, tighten the plug cap to a specified torque of 21 ± 3 N·m.

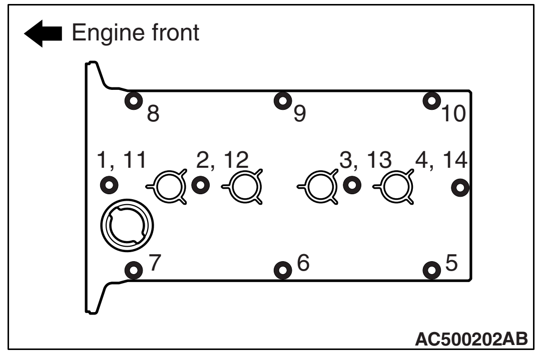
>>H<< ROCKER COVER INSTALLATION

1. Completely remove existing form-in-place gasket from the rocker cover and cylinder head.



2. Apply beads of FIPG on the surfaces of the rocker cover indicated in the illustration.

   Specified sealant:
   Mitsubishi Genuine Part No. 970389 or equivalent



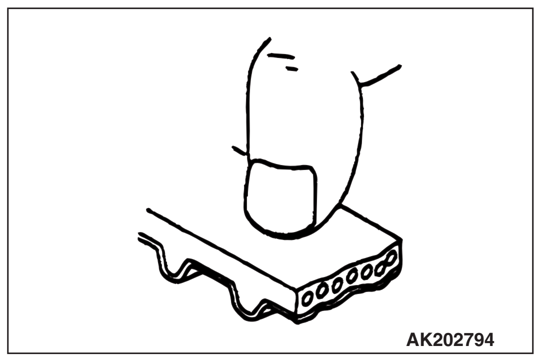
3. Install the rocker cover to the cylinder head before the FIPG hardens, and tighten the tightening bolt to the specified torque of 3.5 ± 0.5 N·m.

INSPECTION

M1113002000812

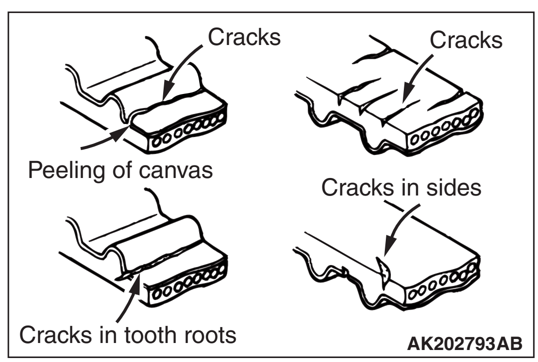
TIMING BELT

Check closely the entire timing belt.
Replace it if any of the following conditions is found.



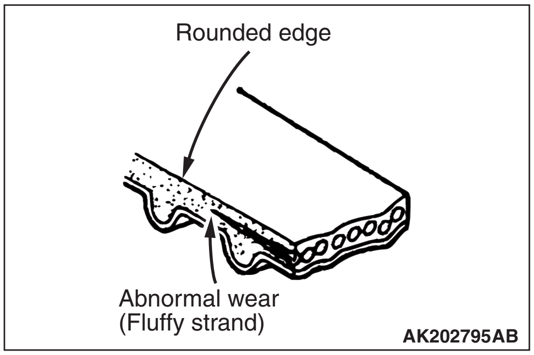
1. Hardened back side rubber.

   Back side surface is glossy, lacking in elasticity, and so hard that no impression is left when pressed with fingernail.



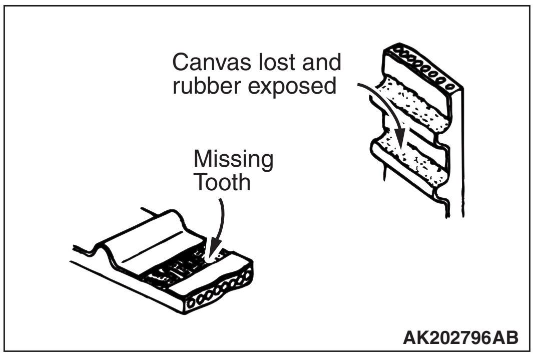
2. Cracks in back rubber surface.
3. Cracks in canvas.
4. Cracks in tooth roots.
5. Cracks in belt sides.

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6. Abnormally worn belt sides.

   NOTE: belt sides are normal if they have "knife-cut" surfaces.



7. Badly worn teeth.

Initial stage: Canvas is worn (canvas fiber is fluffy; teeth look whitish due to worn-out rubber; canvas texture is unclear)

Second stage: Canvas is lost and rubber is exposed (tooth width narrows down)

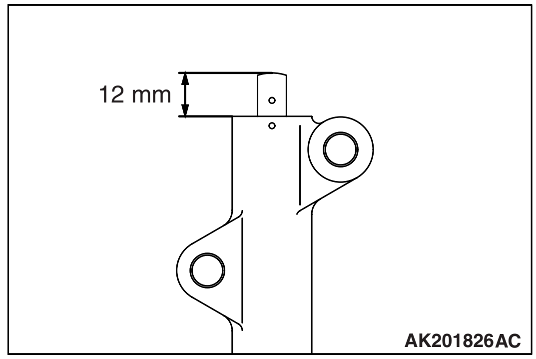
8. Missing tooth.

AUTO-TENSIONER

1. Check the auto-tensioner for leaks from the sealed sections.

   Replace it if leaky.
2. Check the rod end for wear and other damage.

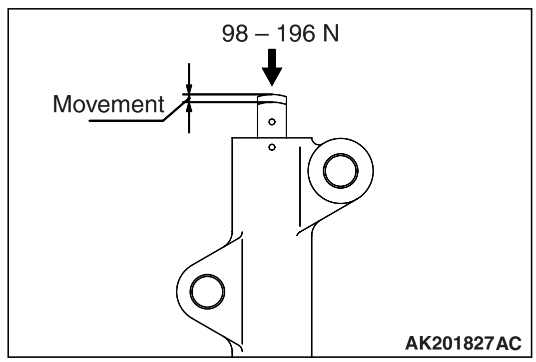
   Replace the auto-tensioner if the rod is badly worn or damaged.



3. Measure the extension length of the rod.

   If it is not within the standard value range, replace the auto-tensioner.

   Standard value: 12 mm



4. Press the rod with a force of 98 – 196 N and measure the amount of retraction. If the measurement exceeds the standard value, replace the auto-tensioner.

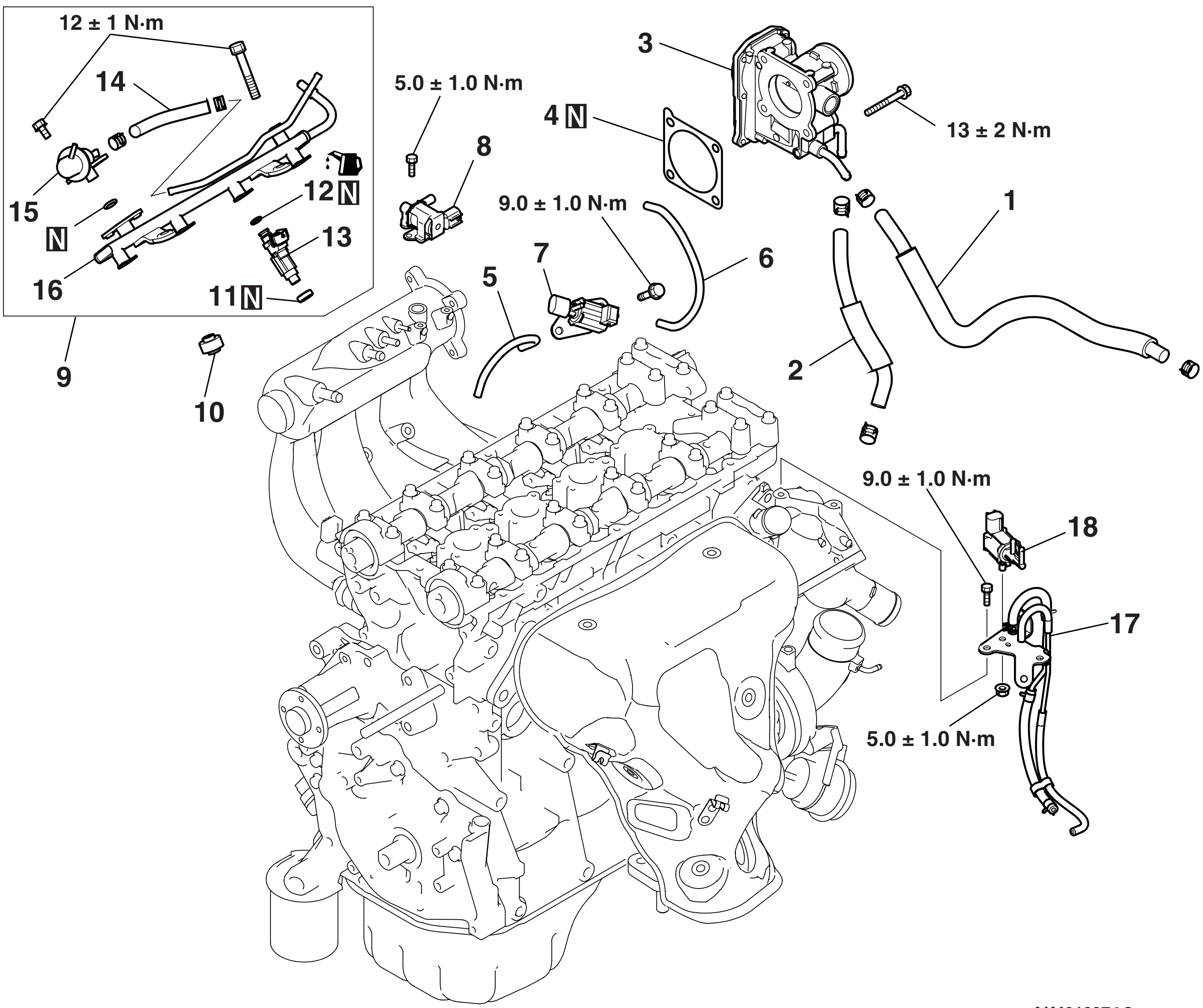
   Standard value: 1 mm maximum

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FUEL AND EMISSION PARTS

REMOVAL AND INSTALLATION

M1113002201251



AK401837AC

Removal steps

1. Water hose
2. Water hose
3. Throttle body
>>**B**<< 4. Throttle body gasket
5. Vacuum hose
6. Vacuum hose
7. Solenoid valve
8. Purge valve
9. Delivery pipe and injector
10. Insulator

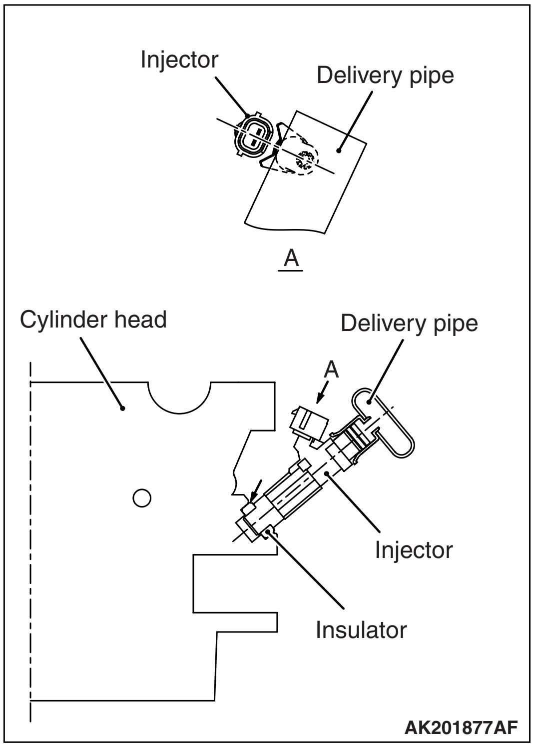
Removal steps (Continued)

11. Insulator
12. O-ring
>>**A**<< 13. Injector
14. Fuel hose
15. Fuel pressure regulator
>>**A**<< 16. Delivery pipe
17. Vacuum pipe and hose
18. Solenoid valve

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INSTALLATION SERVICE POINTS

>>A<< INJECTOR/DELIVERY PIPE INSTALLATION



1. Fit the insulator onto the injector.

⚠ CAUTION

Take care that no engine oil enters the delivery pipe.

2. Apply a little fresh engine oil to the injector O-ring.

   Then, insert the injector, center to center, into the injector mounting hole on the delivery pipe.

3. Make sure that the injector connector projection is properly engaged with the delivery pipe.

   Turn the injector to ensure engagement if necessary.

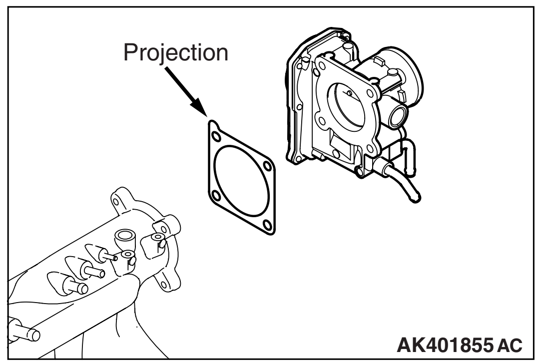
4. Check that the injector rotates smoothly. If it does not, remove it and check the injector O-ring for damage. If damage is evident, replace the O-ring, reinstall the injector to the delivery pipe and check it again for smooth rotation.
5. Install the delivery pipe to the cylinder head.

⚠ CAUTION

Connect the injector securely, having no air leakage from the insulator.

6. Install the insulator, connecting securely to the injector without the clearance.

>>B<< THROTTLE BODY GASKET INSTALLATION



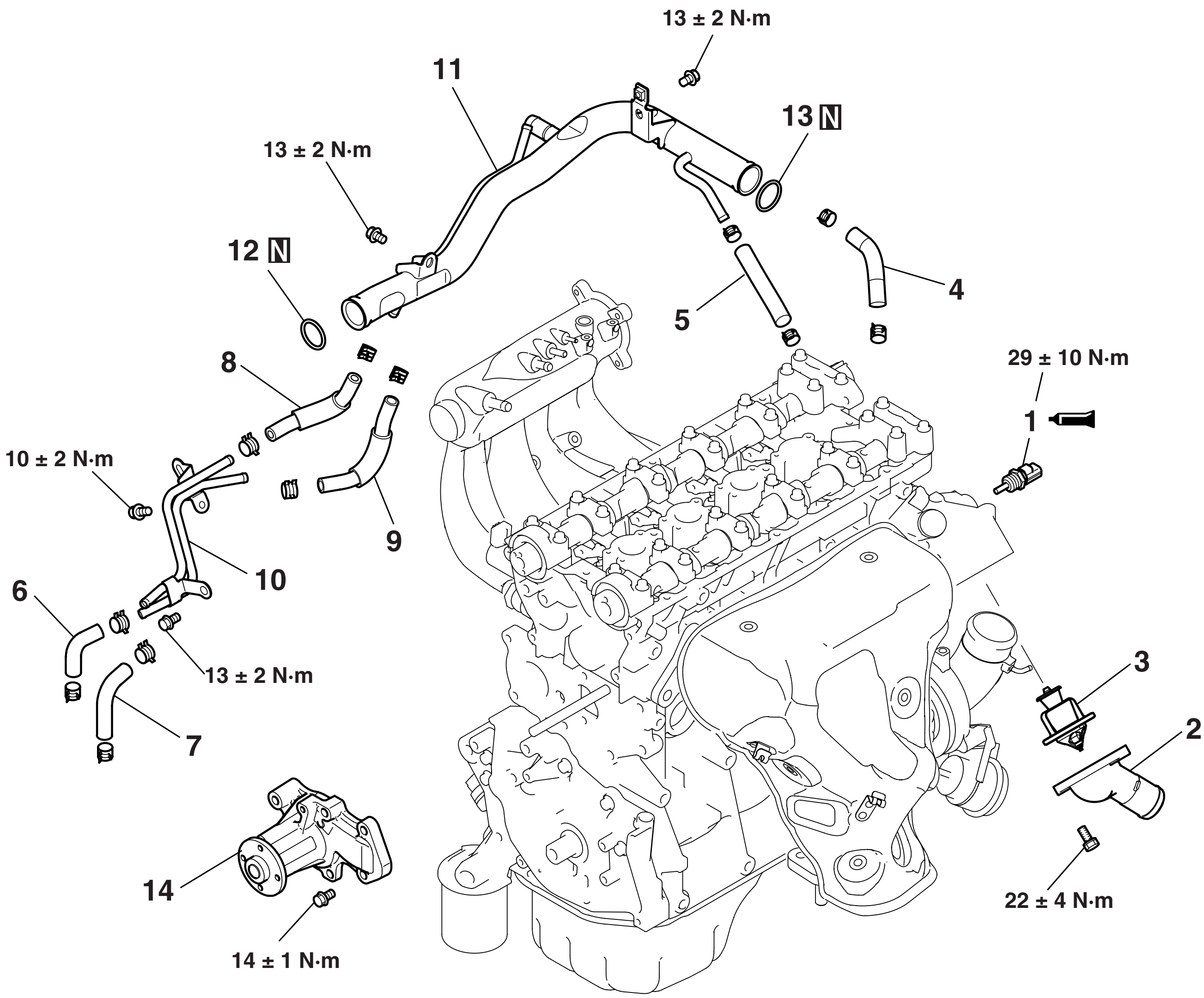
Install the throttle body gasket, facing the gasket's protruded portion in the illustrated position.

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WATER PUMP AND WATER HOSE

REMOVAL AND INSTALLATION

M1113017900468



Removal steps

- >>**C**<< 1. Engine coolant temperature sensor
- 2. Water inlet fitting
- >>**B**<< 3. Thermostat
- 4. Water hose
- 5. Water hose
- 6. Water hose
- 7. Water hose
- 8. Water hose

Removal steps (Continued)

- 9. Water hose
- 10. Water pipe
- >>**A**<< 11. Water inlet pipe
- >>**A**<< 12. O-ring
- >>**A**<< 13. O-ring
- 14. Water pump

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INSTALLATION SERVICE POINTS

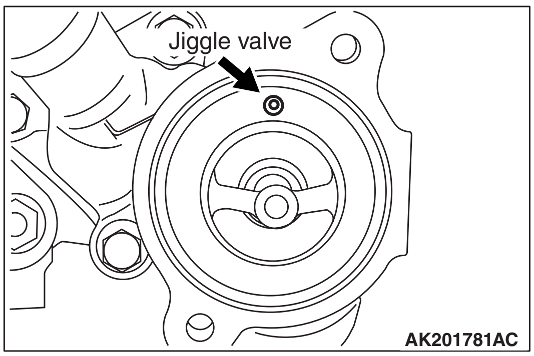
>>A<< O-RING/WATER INLET PIPE INSTALLATION

⚠ CAUTION

- **Do not apply engine oil or any other oily substance to the O-rings.**
- **Secure the water pipe after the thermostat case has been installed.**

Replace the water inlet pipe O-rings with new ones, then apply water to the O-rings so that they can be inserted easily into the water pump and thermostat case.

>>B<< THERMOSTAT INSTALLATION

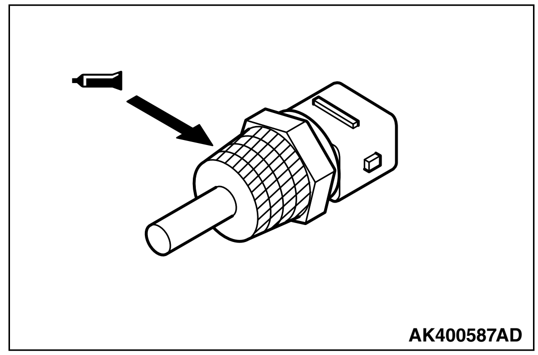


Install the thermostat to the thermostat housing so that its jiggle valve can locate around the center.

>>C<< ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

⚠ CAUTION

Take care not to damage the connector (plastic) with tool.



1. Completely remove existing sealant from the engine coolant temperature sensor and mating hole in the thermostat housing.
2. Apply the specified sealant to the threads of the sensor.

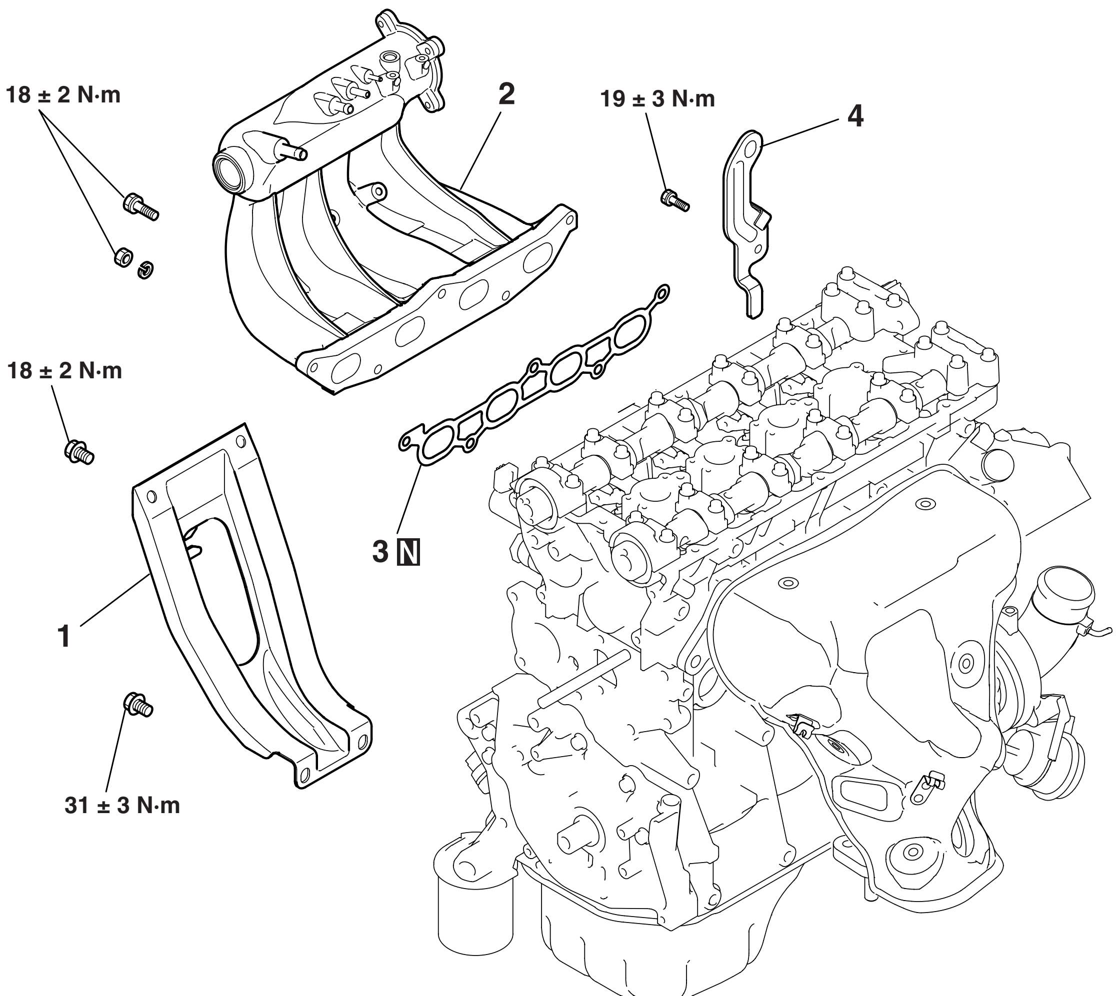
   Specified sealant:
   3M Nut Locking Part No.4171 or equivalent
3. Tighten the water temperature sensor together with the thermostat housing to the specified torque of 29 ± 10 N·m.

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INLET MANIFOLD

REMOVAL AND INSTALLATION

M1113026100169



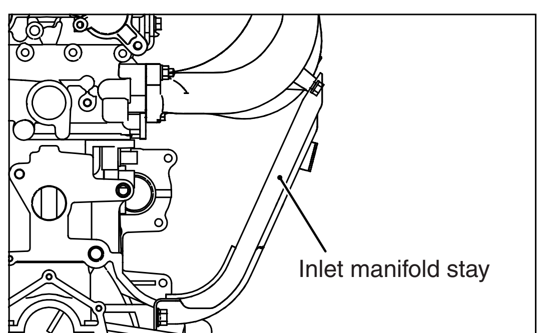
AK401840AC

Removal steps

>>**A**<< 1. Inlet manifold stay
2. Inlet manifold
3. Inlet manifold gasket
4. Engine hanger

INSTALLATION SERVICE POINTS

>>A<< INLET MANIFOLD STAY INSTALLATION



AK401854AC

Make sure that the inlet manifold stay tightly fits the inlet manifold and the mating boss of the cylinder block, then tighten bolts the specified torques.

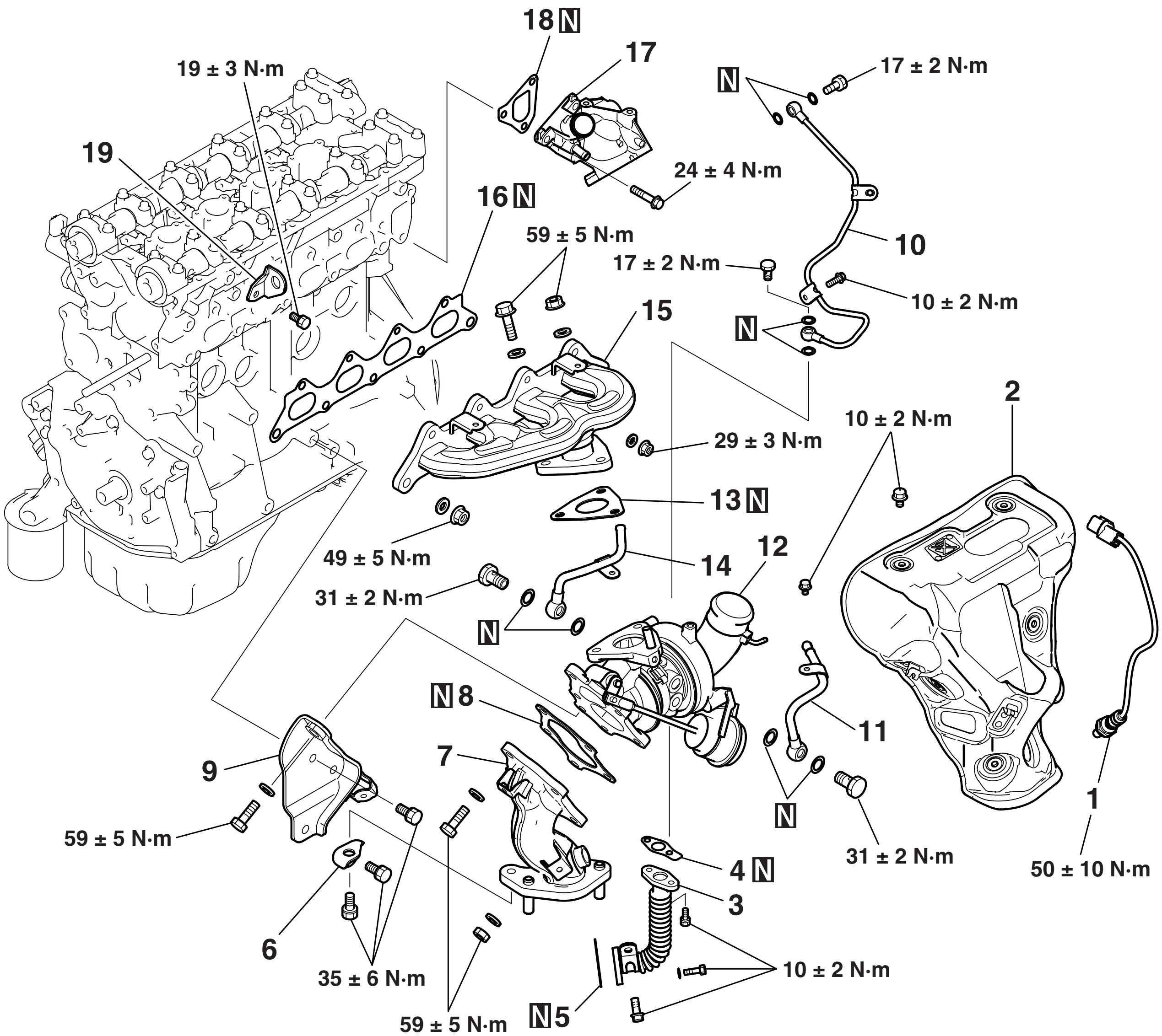
Tightening torque:
M8 18 ± 2 N·m
M10 31 ± 3 N·m

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EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004900918



AK401835AB

Removal steps

1. Oxygen sensor
2. Turbocharge cover
3. Oil return pipe

>>**C**<< 4. Oil return pipe gasket

>>**C**<< 5. Oil return pipe gasket

>>**B**<< 6. Exhaust fitting bracket

7. Exhaust fitting
8. Exhaust fitting gasket
9. Turbocharger bracket
10. Oil pipe

>>**A**<< 11. Water pipe "B"

Removal steps (Continued)

12. Turbocharger
13. Turbocharger gasket

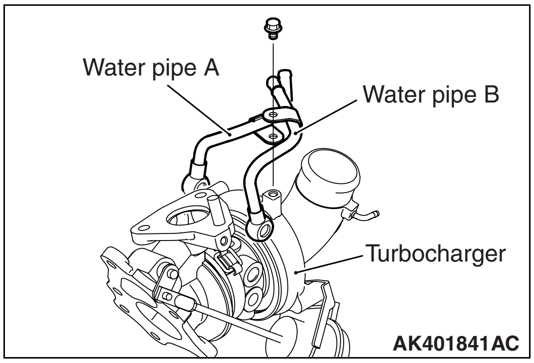
>>**A**<< 14. Water pipe "A"

15. Exhaust manifold
16. Exhaust manifold gasket
17. Thermostat housing
18. Thermostat housing gasket
19. Engine hanger

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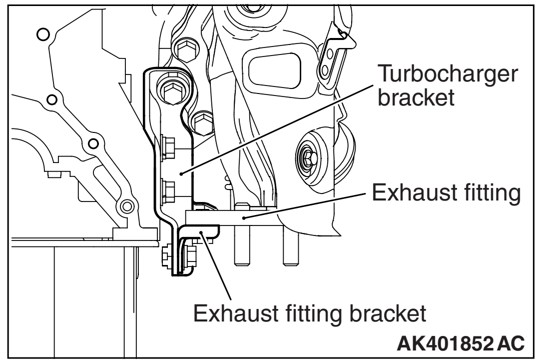
INSTALLATION SERVICE POINTS

>>A<< WATER PIPE INSTALLATION



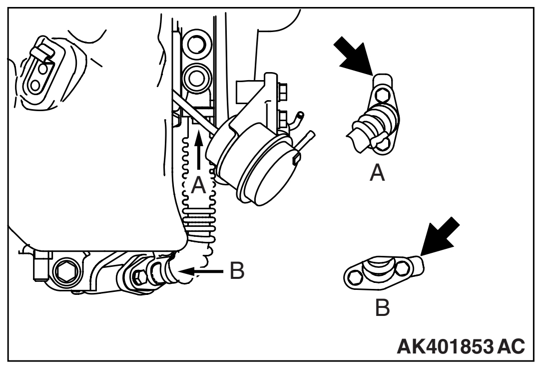
Put the bracket of the water pipe "B" over the bracket of the water pipe "A" as shown in the illustration. Tighten them together with the turbocharger to the tightening torque of 10 ± 2 N·m.

>>B<< EXHAUST FITTING BRACKET INSTALLATION



Make sure that the exhaust fitting bracket fits exactly the exhaust fitting and the turbocharger bracket. Tighten the exhaust fitting bracket to the specified torque of 35 ± 6 N·m.

>>C<< OIL RETURN PIPE GASKET INSTALLATION



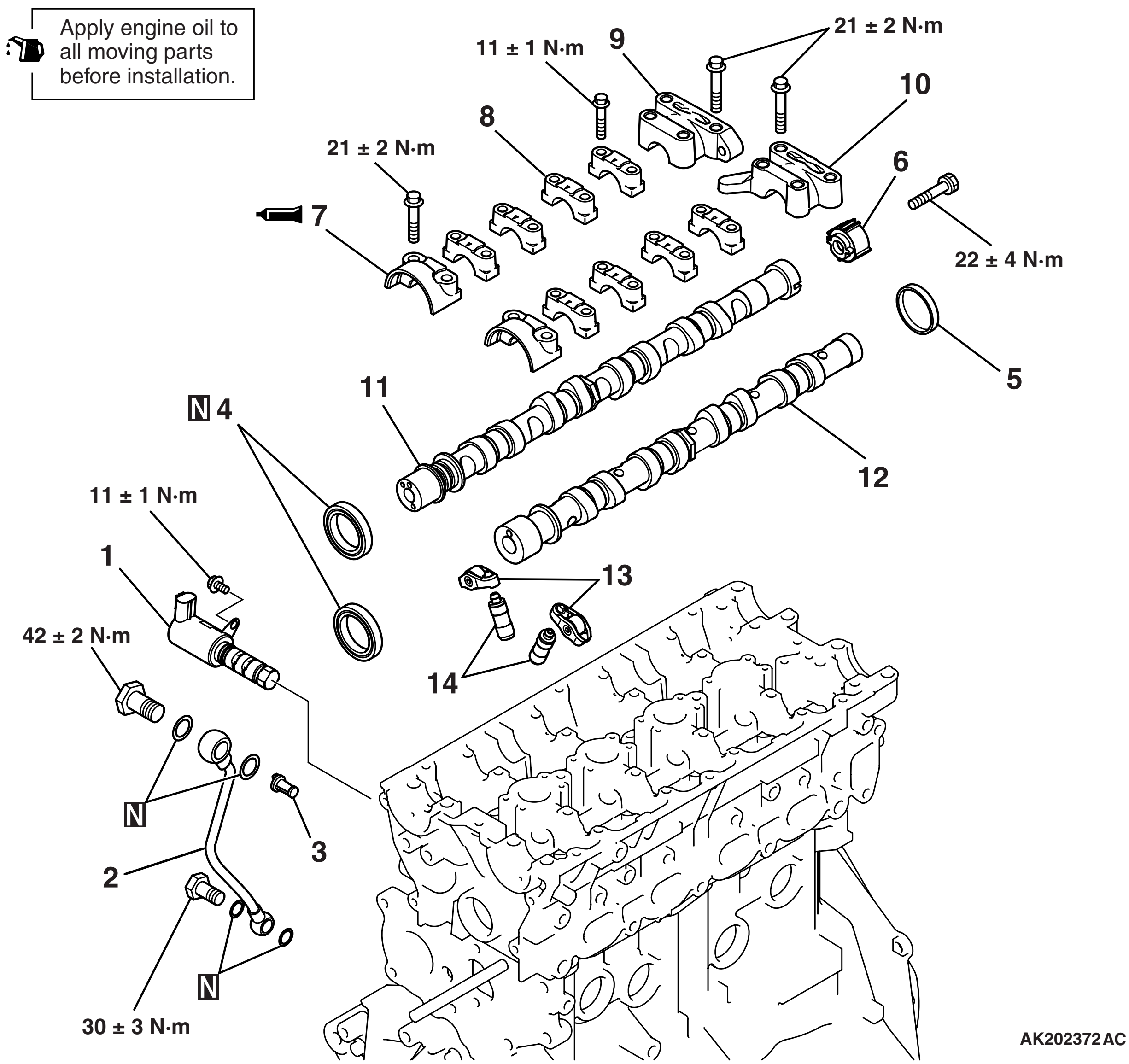
Install the projection of the oil return pipe gasket to the turbocharger and the oil pan as shown in the illustration.

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ROCKER ARMS AND CAMSHAFT

REMOVAL AND INSTALLATION

M1113005401414



Removal steps

- >>**H**<< 1. Oil feeder control valve
- 2. Oil pipe
- >>**G**<< 3. Oil feeder control valve filter
- >>**F**<< 4. Oil seal
- >>**E**<< 5. Circular packing
- <<**A**>> >>**D**<< 6. Cam position sensing cylinder
- >>**C**<< 7. Front bearing cap
- >>**C**<< 8. Bearing cap

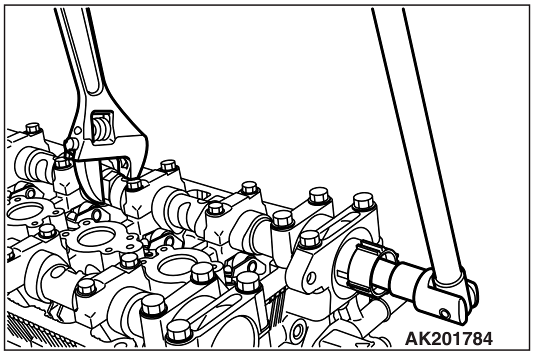
Removal steps (Continued)

- >>**C**<< 9. Rear right bearing cap
- >>**C**<< 10. Rear left bearing cap
- >>**B**<< 11. Intake camshaft
- >>**B**<< 12. Exhaust camshaft
- 13. Roller rocker arm
- <<**B**>> >>**A**<< 14. Lash adjuster

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REMOVAL SERVICE POINTS

<<A>> CAM POSITION SENSING CYLINDER REMOVAL



Holding the hexagonal portion of the camshaft with a wrench, remove the cam position sensing cylinder.

<<B>> LASH ADJUSTER REMOVAL

⚠ CAUTION

If the lash adjuster is to be reused, be sure to clean and inspect it before installation. (Refer toP.11D-30.)

INSTALLATION SERVICE POINTS

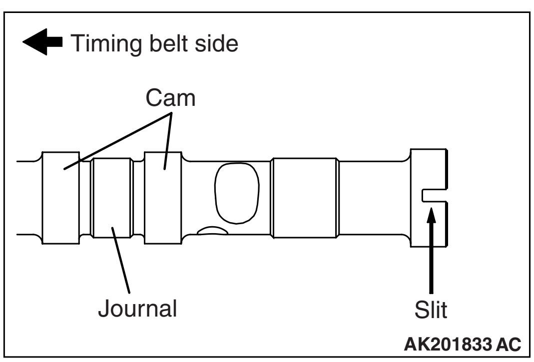
>>A<< LASH ADJUSTER INSTALLATION

⚠ CAUTION

If the lash adjuster is to be reused, be sure to clean and inspect it before installation. (Refer toP.11D-30.)

While using care not to spill diesel fuel in the lash adjuster, install the lash adjuster on the rocker arm.

>>B<< CAMSHAFT INSTALLATION

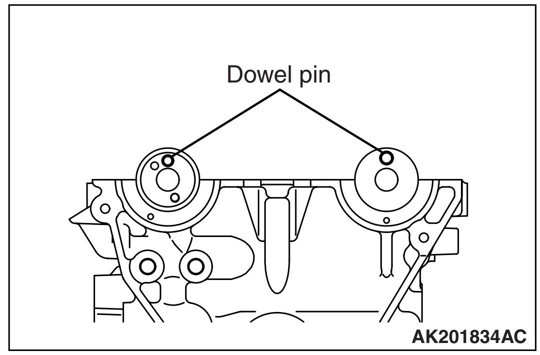


⚠ CAUTION

- **Do not confuse intake and exhaust camshafts.**
- **A 4 mm slit is on the rear end of the intake camshaft.**

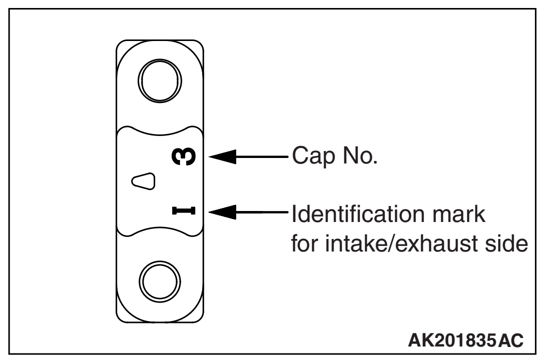
Apply engine oil to the camshaft journal and cams before installation.

>>C<< FRONT BEARING CAP/BEARING CAP/REAR RIGHT BERING CAP/REAR LEFT BEARING CAP INSTALLATION



1. Place the dowel pins of the camshafts in the positions shown in the illustration.

   NOTE: By getting the dowel pins into position shown in the illustration, the camshaft slots of tightening the cylinder head bolt are put in position.



2. The bearing caps No. 2 to 5 are identical in shape. Before installation, be sure to check the cap numbers and identification marks so that right bearing caps are installed in right places.

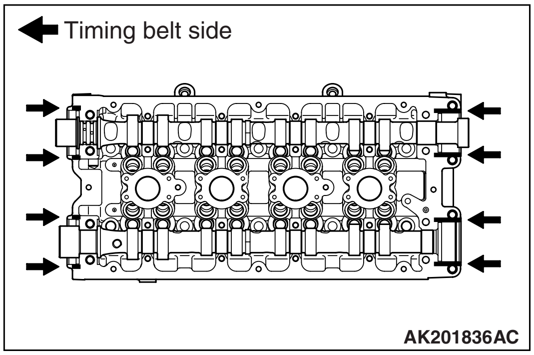
   Identification marks (Die-stamped on front and No. 2 to 5 bearing caps)

   I: Intake side

   E: Exhaust side

3. Completely remove existing sealant from the bearing caps and cylinder head.

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4. Apply specified sealant to the cylinder head at the points shown in the illustration.

Specified sealant:
3M ATD No.8660 or equivalent

5. Install the bearing caps in position and tighten bolts increasingly by giving turns 2 to 3 times each.

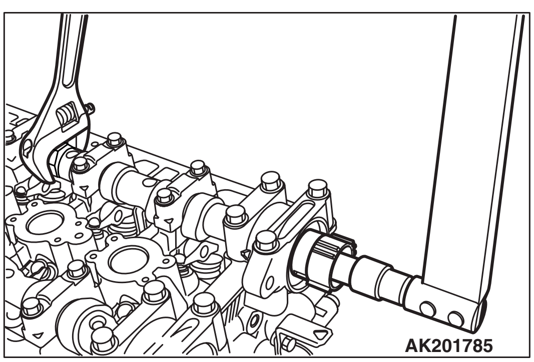
NOTE: Completely wipe off excess of applied sealant that comes out.

6. Finally, tighten the bearing cap bolts to a specified torque.

Specified torque
Front bearing cap: 21 ± 2 N·m
Bearing cap: 11 ± 1 N·m
Rear right bearing cap: 21 ± 2 N·m
Rear left bearing cap: 21 ± 2 N·m

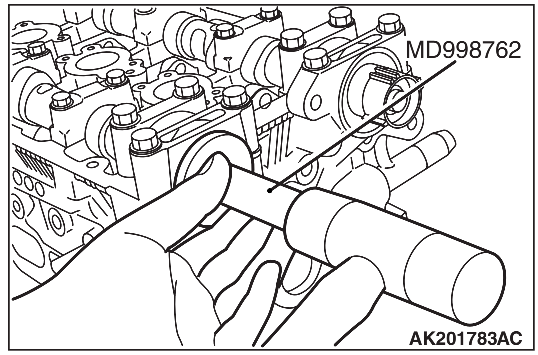
7. Check that the rocker arms are installed in position.

>>D<< CAM POSITION SENSING CYLINDER INSTALLATION



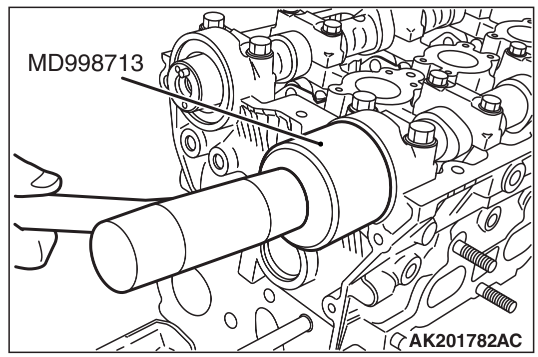
Holding the hexagonal portion of the camshaft, tighten the cam position sensing cylinder to a specified torque of 22 ± 4 N·m.

>>E<< CIRCULAR PACKING INSTALLATION



Using the special tool Circular packing installer (MD998762), install the circular packing into the cylinder head.

>>F<< OIL SEAL INSTALLATION



Using the special tool Oil seal installer (MD998713), install the oil seal into the cylinder head.

>>G<< OIL FEEDER CONTROL VALVE FILTER INSTALLATION

⚠ CAUTION

Check the filter for foreign matters, damage and deformation before installation.

>>H<< OIL FEEDER CONTROL VALVE INSTALLATION

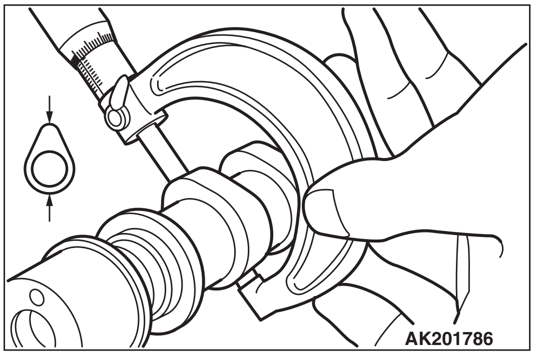
1. Apply a small amount of engine oil to the o-ring of the oil feeder control valve.
2. Install the oil feeder control valve to the cylinder head.
3. Tighten the oil feeder control valve bolt to the specified torque of 11 ± 1 N·m.

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INSPECTION

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CAMSHAFT



Measure the cam height (nose-to-heel diameter). If any cam is worn beyond the limit, replace the camshaft.

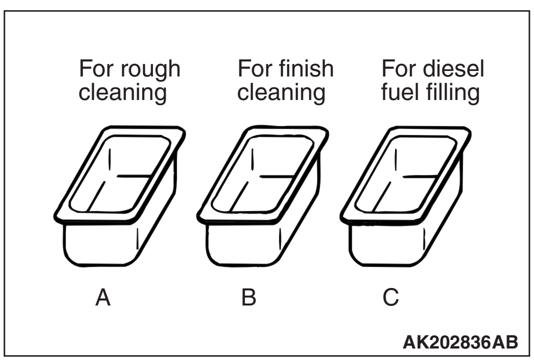
Standard values:
Intake 35.08 mm
Exhaust 34.26 mm

Limit:
Intake 34.58 mm
Exhaust 33.76 mm

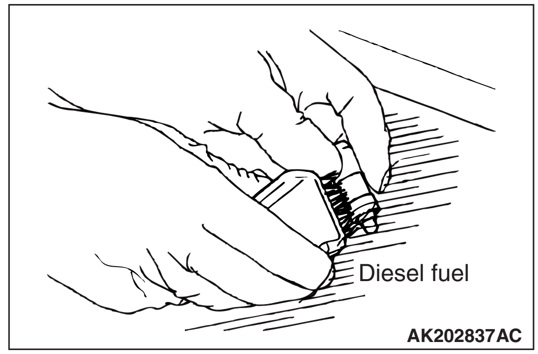
LASH ADJUSTERS

⚠ CAUTION

- **The lash adjuster is a precision-engineered component. Do not allow dust or other foreign matter to enter it.**
- **Do not disassemble lash adjusters.**
- **Use only non-contaminated diesel fuel to clean the lash adjuster.**

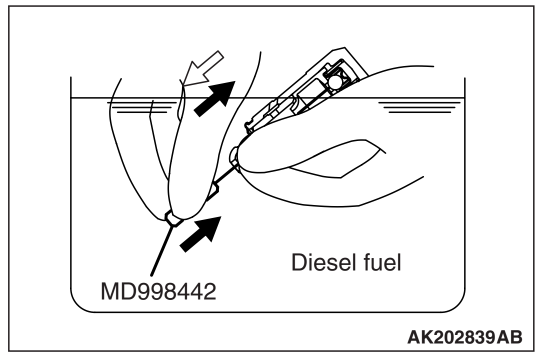


1. Prepare three containers and approximately five liters of diesel fuel. Pour into each container the diesel fuel in an amount enough for a lash adjuster placed in the container in its upright position to completely submerge.



2. Place the lash adjuster in container A and wash its outside surface.

   NOTE: Use a nylon brush if there are hard-to-remove deposits.

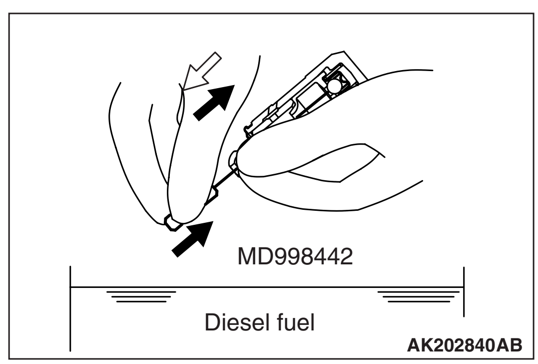


⚠ CAUTION

The steel ball spring of the lash adjuster is extremely weak. The lash adjuster's functionality may be badly affected if the special tool is inserted too strongly.

3. While gently pushing the internal steel ball using the special tool Air bleed wire (MD998442), move the plunger in and out 5 – 10 times to eliminate stiffness in the plunger and expel contaminated oil.

   NOTE: The plunger must be free from jamming and any other abnormalities. If a defect is found in plunger operation, replace the lash adjuster.

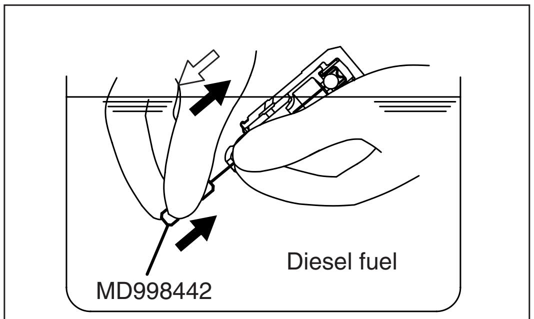


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⚠ CAUTION

The hole in the side of the lash adjuster must be directed toward the inside of container A. Never direct it against any person.

4. Take the lash adjuster out of the container, then move the plunger by pushing the steel ball gently to discharge the diesel fuel from the pressure chamber.

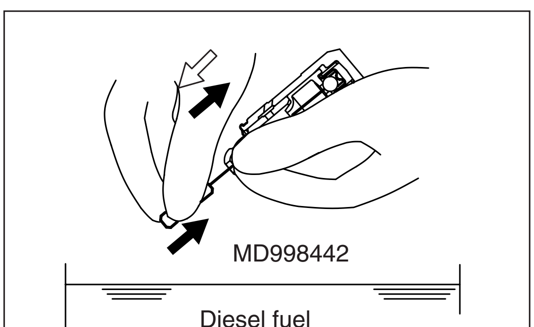


AK202839AB

⚠ CAUTION

The steel ball spring of the lash adjuster is extremely weak. The lash adjuster's functionality may be badly affected if the special tool is inserted too strongly.

5. Soak the lash adjuster in the diesel fuel in container B. Move the plunger in and out 5 – 10 times by gently pushing the internal steel ball using the special tool Air bleed wire (MD998442) until the plunger moves smoothly to wash the lash adjuster’s pressure chamber.

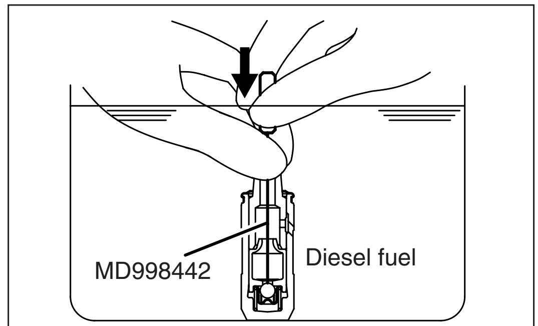


AK202840AB

⚠ CAUTION

The hole in the side of the lash adjuster must be directed toward the inside of container B. Never direct it against any person.

6. Take the lash adjuster out of the container, then move the plunger by pushing the steel ball gently to discharge the diesel fuel from the pressure chamber.

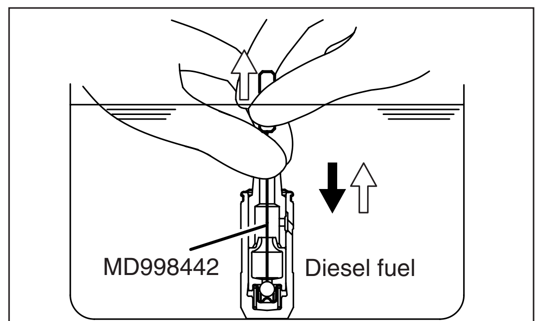


AK202841AB

⚠ CAUTION

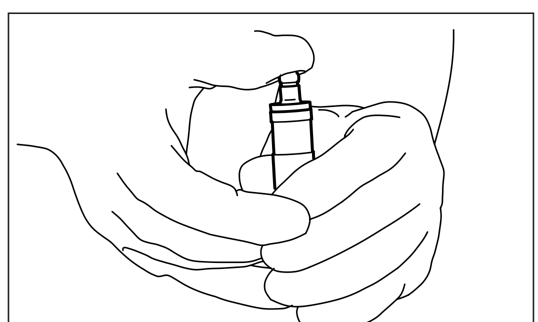
Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when the chamber is filled with diesel fuel.

7. Soak the lash adjuster in the diesel fuel in container C. Gently push the internal steel ball using the special tool Air bleed wire (MD998442).



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8. Place the lash adjuster upright with the plunger at the top. Push the plunger firmly until it makes a full stroke, then return the plunger slowly and release the hold of the steel ball to allow the pressure chamber to be filled with diesel fuel.


AK202843

9. Take the lash adjuster out of the container, place it upright with the plunger at the top, and push the plunger firmly. The plunger must not move at all.

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NOTE: If the lash adjuster contracts, perform the operations 7 through 9 again. Replace the lash adjuster if it still contracts even after the pressure chamber has completely been filled with diesel fuel (air has been bled).

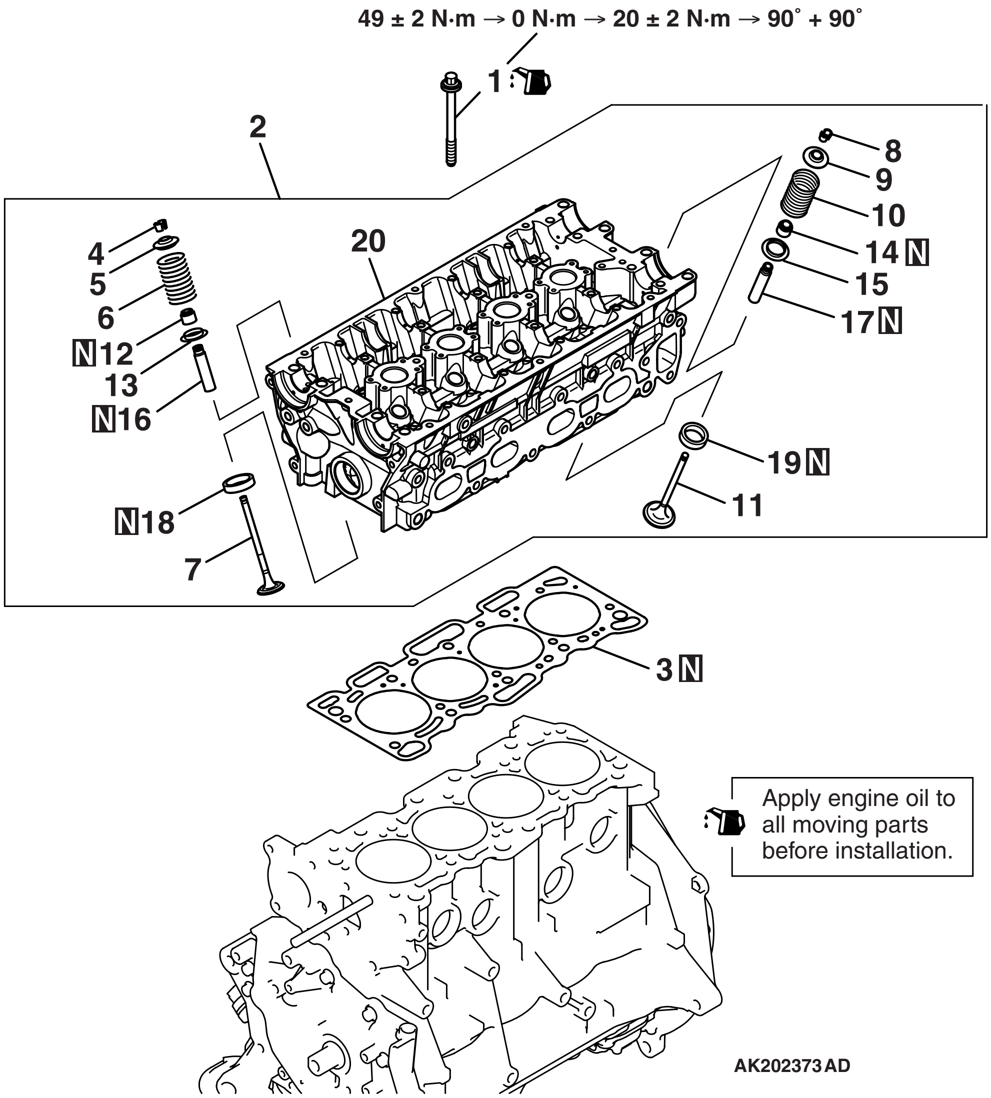
10. Keep the serviced lash adjusters in their upright positions to prevent diesel fuel from spilling out. Protect them from dust or other foreign matter. Install the lash adjusters onto the engine as soon as possible.

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CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006901003



Removal steps

<<**A**>> >>**D**<< 1. Cylinder head bolt
2. Cylinder head assembly
3. Cylinder head gasket
<<**B**>> >>**C**<< 4. Retainer lock
5. Valve spring retainer
>>**B**<< 6. Valve spring
7. Intake valve
<<**B**>> >>**C**<< 8. Retainer lock
9. Valve spring retainer
>>**B**<< 10. Valve spring
11. Exhaust valve

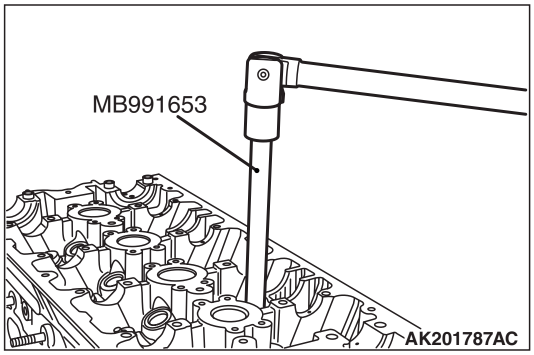
Removal steps (Continued)

>>**A**<< 12. Valve stem seal
13. Valve spring seat
>>**A**<< 14. Valve stem seal
15. Valve spring seat
16. Intake valve guide
17. Exhaust valve guide
18. Intake valve seat
19. Exhaust valve seat
20. Cylinder head

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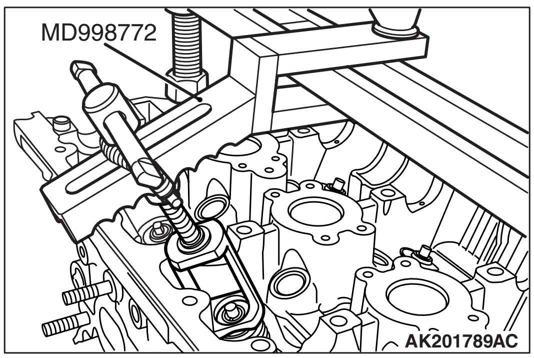
REMOVAL SERVICE POINTS

<<A>> CYLINDER HEAD BOLT REMOVAL



Use the special tool Cylinder head bolt wrench (MB991653) to loosen the cylinder head bolts.

<<B>> RETAINER LOCK REMOVAL



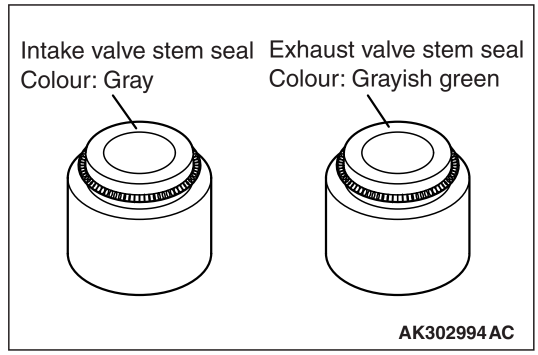
Compress the valve spring using the special tool Valve spring compressor (MD998772), then remove the retainer lock.

NOTE: Store removed valves, springs and other parts, after putting to each of them a tag that identifies its cylinder No. or installation location.

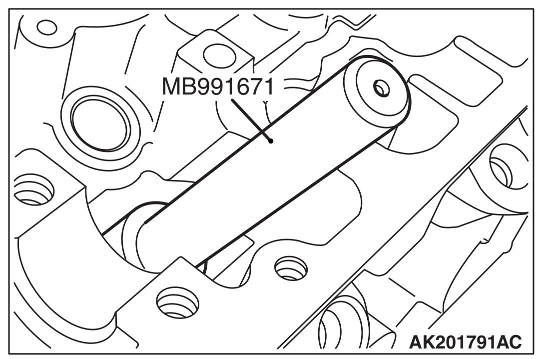
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION

1. Install the valve spring seat.
2. Install the valve.
3. Apply a thin coat of engine oil to a new valve stem seal.



NOTE: Do not confuse the stem seals for intake valves with those for exhaust valves.



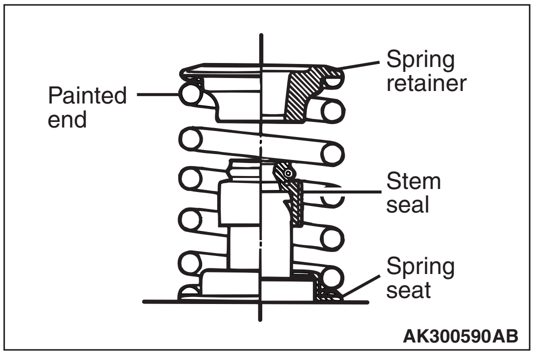
⚠ CAUTION

- **Do not reuse the valve stem seal.**
- **The special tool must always be used when installing the valve stem seal. Improper installation could result in oil leaks past the valve guide.**

4. Use the special tool Valve seal installer (MB991671) to install the stem seal on the valve guide. Use the stem of the valve to guide the stem seal.

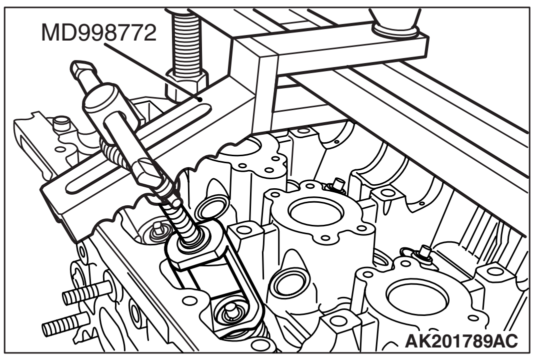
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>>B<< VALVE SPRING INSTALLATION



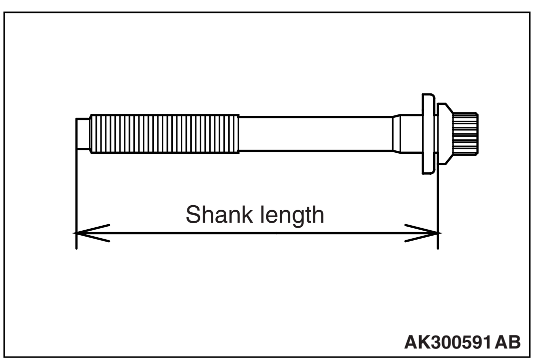
Install each valve spring with the painted end toward the rocker arm.

>>C<< RETAINER LOCK INSTALLATION



Compress the valve spring using the special tool Valve spring compressor (MD998772), then install the retainer lock.

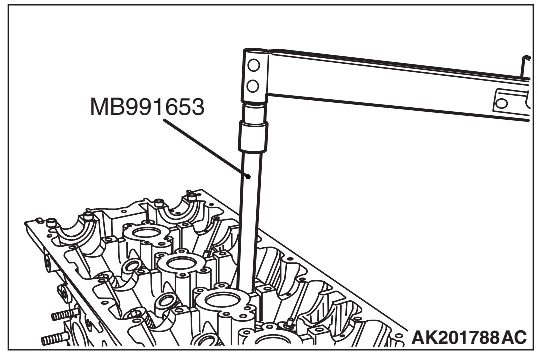
>>D<< CYLINDER HEAD BOLT INSTALLATION



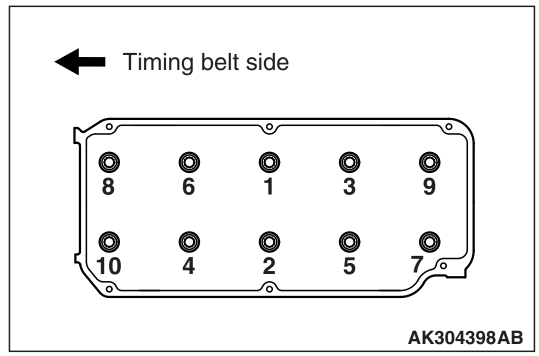
1. When reusing a cylinder head bolt, check that its nominal length (shank length) is not greater than the limit. If the limit is exceeded, replace the bolt.

   Limit: 103.2 mm

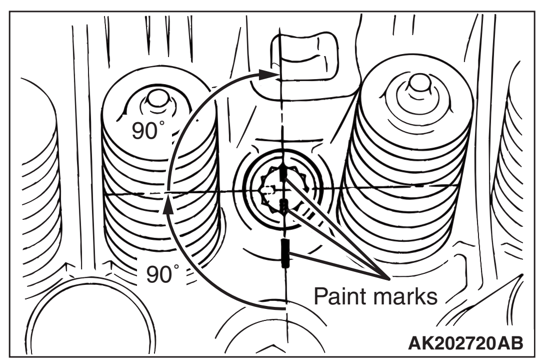
2. Apply engine oil to the threads and washer of the bolt.



NOTE: Use the special tool Cylinder head bolt wrench (MB991653) to tighten the bolts.



3. Tighten the bolts to 49 ± 2 N·m in the indicated sequence.
4. Loosen all the bolts completely.
5. Tighten the bolts again to a torque of 20 ± 2 N·m in the indicated sequence.



⚠ CAUTION

- **If the tightening angle is smaller than 90°, proper fastening performance could not be assured. Be sure to respect that angle.**
- **If the bolt is tightened to an angle greater than the specified angle, loosen the bolt completely and then retighten it beginning with the first step.**

6. Make paint marks on each bolt's head and on the cylinder head.
7. Turn the bolts 90° in the tightening direction and in the indicated sequence.

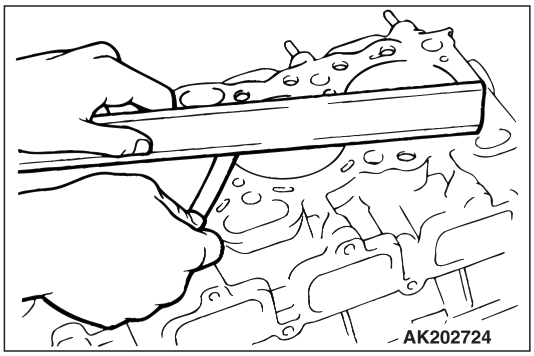
8. Give another 90° turn in the tightening direction to each bolt, making sure that the paint mark on the bolt head and that on the cylinder head are on the same line.

INSPECTION

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CYLINDER HEAD

1. Before cleaning the cylinder head, check it for traces of water and gas leakage and for cracks and any other damage.
2. Thoroughly remove oils, scale, sealants, carbon and other contamination. Clean the oil passages, then check using compressed air that they are not blocked.



3. Check the cylinder head gasket surface for warp using a straightedge and thickness gauge.

   If the surface is warped beyond the limit, grind the surface for rectification.

⚠ CAUTION

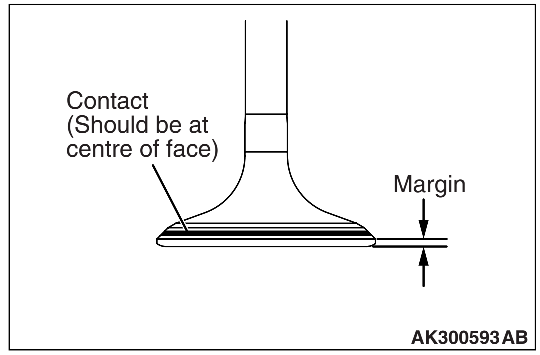
The thickness of the metal that can be removed by grinding from both the cylinder head and the mating cylinder block is limited to 0.2 mm in total.

Gasket surface warp
Standard value: 0.03 mm or less
Limit: 0.2 mm
Grinding limit: 0.2 mm

Cylinder head height (standard value for new part):
131.9 – 132.1 mm

VALVES

1. Check the valve face for correct contact with the seat. Reface the valve if the contact is partial or one sided.

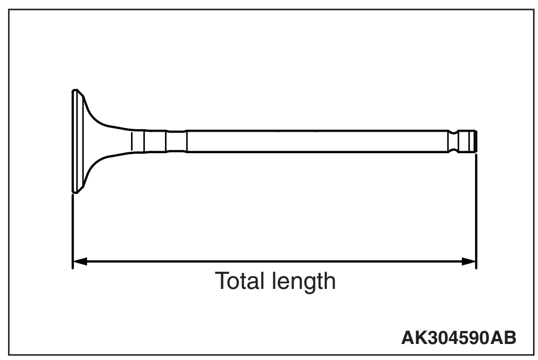


2. Measure the margin.

   Replace the valve if its margin is smaller than the limit.

Standard values:
Intake 1.0 mm
Exhaust 1.5 mm

Limits:
Intake 0.5 mm
Exhaust 1.0 mm



3. Measure the total length of the valve.

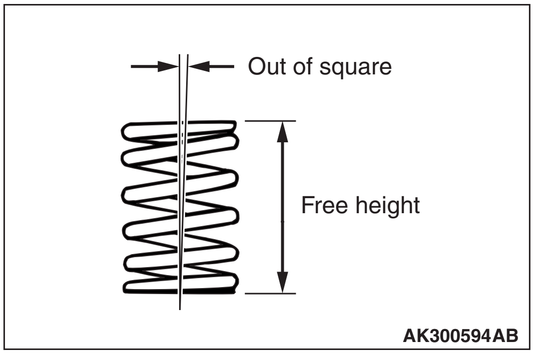
   Replace the valve if the length is less than the limit.

Standard values:
Intake 106.35 mm
Exhaust 106.85 mm

Limits:
Intake 105.85 mm
Exhaust 106.35 mm

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VALVE SPRINGS



1. Measure the free height of the spring.

   Replace the spring if its height is smaller than the limit.

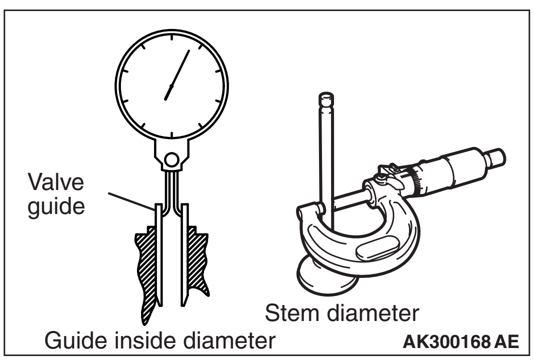
   Standard value: 54.8 mm
   Limit:53.8 mm

2. Measure the squareness of the spring.

   Replace the spring if it is out of square beyond the limit.

   Standard value: 2° or less
   Limit: 4°

VALVE GUIDE

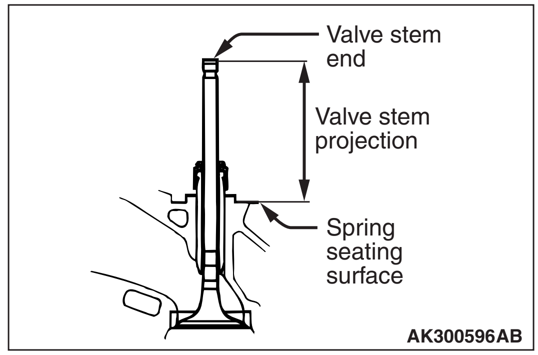


Measure the valve guide inside diameter and valve stem diameter to calculate the clearance between the valve guide and valve stem.
If the limit is exceeded, replace the valve guide or valve, or both.

Standard values:
Intake 0.02 – 0.05 mm
Exhaust 0.03 – 0.06 mm

Limits:
Intake 0.10 mm
Exhaust 0.15 mm

VALVE SEATS



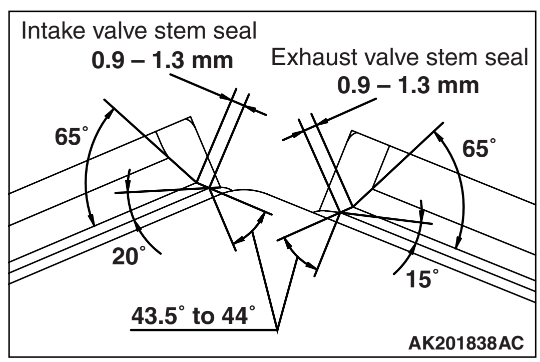
With the valve installed in position and its face pressed against the valve seat, measure the valve stem projection (distance between the valve stem end and spring seating surface). If the measurement exceeds the limit, replace the valve seat.

Standard values:
Intake 48.8 mm
Exhaust 48.7 mm

Limits:
Intake 49.3 mm
Exhaust 49.2 mm

VALVE SEAT RECONDITIONING

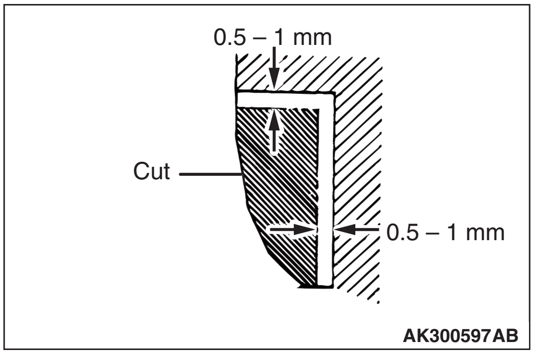
1. Before reconditioning the valve seat, check the clearance between the valve guide and valve stem and, if necessary, replace the valve guide.



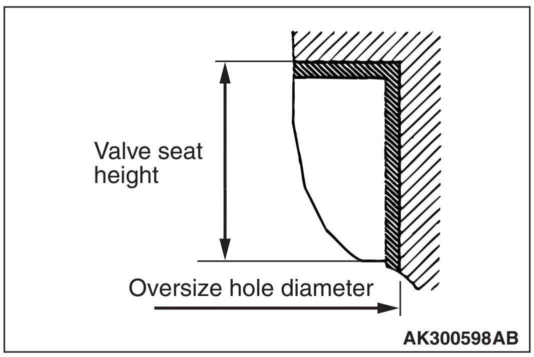
2. Resurface the valve seat to the indicated width and angles.
3. After resurfacing, lap the valve and valve seat using lapping compound.

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VALVE SEAT REPLACEMENT



1. Cut inside of the valve seat to be replaced until its wall becomes thin enough for removal, then remove the valve seat.



2. Rebore the valve seat hole in the cylinder head to a diameter matched to the diameter of the selected oversize valve seat.

   Intake valve seat hole diameters:
   0.3 oversize 31.30 – 31.33 mm
   0.6 oversize 31.60 – 31.63 mm

   Exhaust valve seat hole diameters:
   0.3 oversize 27.80 – 27.82 mm
   0.6 oversize 28.10 – 28.12 mm

3. Before fitting the valve seat, cool it in liquid nitrogen to prevent damage to its hole in the cylinder head due to interference.
4. Resurface the valve seat. See the VALVE SEAT RECONDITIONING section.

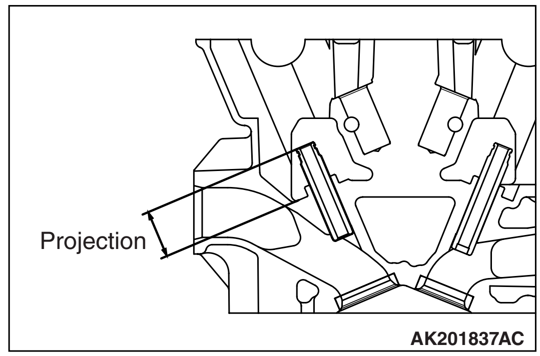
VALVE GUIDE REPLACEMENT

1. Force out the valve guide toward the cylinder block using a press.

⚠ CAUTION
Do not use a replacement valve guide of the same size as the removed one.

2. Machine the valve guide hole in the cylinder head to the size matched to the selected oversize valve guide.

   Valve guide hole diameters
   0.05 oversize: 10.55 – 10.57mm
   0.25 oversize: 10.75 – 10.77 mm
   0.50 oversize: 11.00 – 11.02 mm



3. Press-fit the valve guide until it remains protruded above the cylinder head by the amount indicated in the illustration.

   Standard value: 22.7 – 23.3 mm

   NOTE: Press the valve guide from above the cylinder head.

   NOTE: The valve guides for the intake valves are different in length from those for the exhaust valves (48 mm for intake valves; 55 mm for exhaust valves)

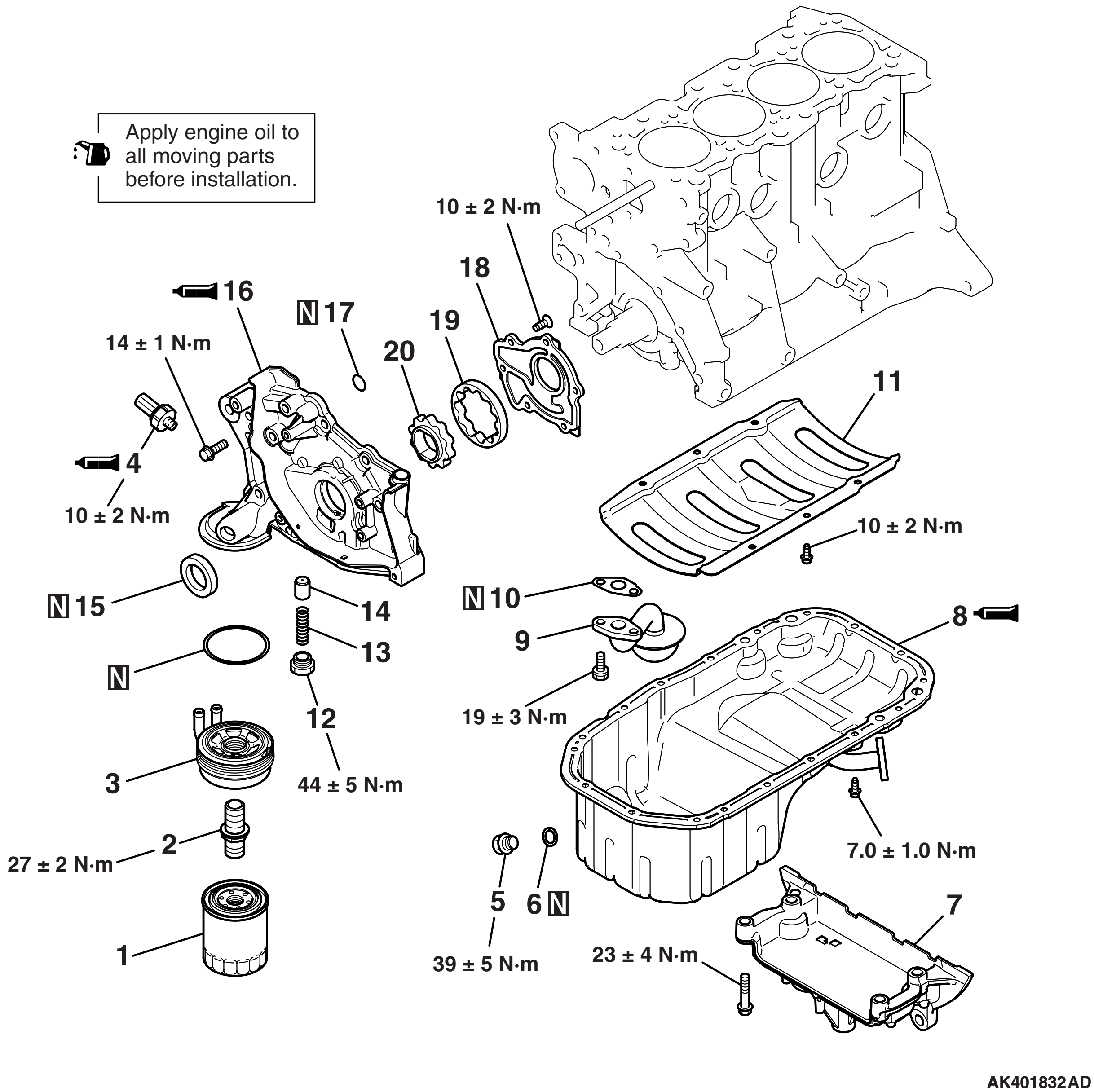
4. After installing the valve guide, insert a new valve in it to check for smooth movement.

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OIL PAN AND OIL PUMP

REMOVAL AND INSTALLATION

M1113008101241



Removal steps

>>**F**<< 1. Oil filter
2. Oil cooler bolt
3. Oil cooler
>>**E**<< 4. Oil pressure switch
>>**D**<< 5. Drain plug
6. Drain plug gasket
7. Transmission stay
<<**A**>> >>**C**<< 8. Oil pan
9. Oil screen
10. Oil screen gasket
11. Baffle plate

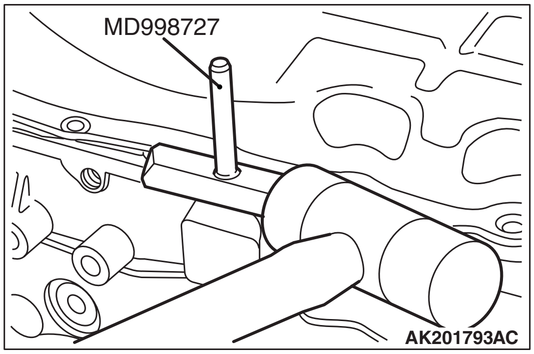
Removal steps (Continued)

12. Relief plug
13. Relief spring
14. Relief plunger
>>**B**<< 15. Front oil seal
>>**A**<< 16. Oil pump case
17. O-ring
18. Oil pump cover
19. Oil pump outer rotor
20. Oil pump inner rotor

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REMOVAL SERVICE POINT

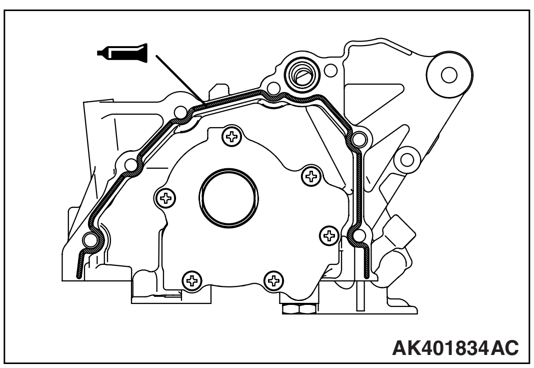
<<A>> OIL PAN REMOVAL



1. Remove the oil pan mounting bolts.
2. Knock the special tool Oil pan remover (MD998727) between the oil pan and cylinder block as shown in the illustration.
3. Tapping the side of the special tool, slide the tool along the oil pan/cylinder block seal and thus remove the oil pan.

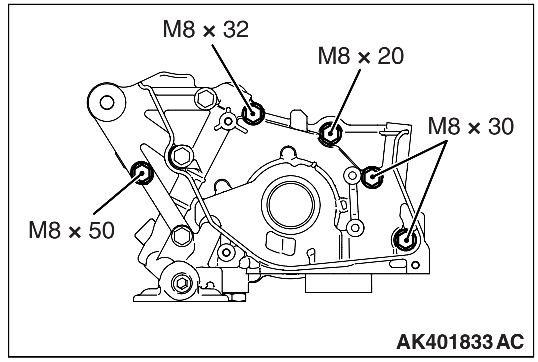
INSTALLATION SERVICE POINTS

>>A<< OIL PUMP CASE INSTALLATION



1. Completely remove existing form-in-place gasket from the cylinder block (oil pump case mounting surface) and oil pump case.
2. Apply a 3 ± 1 mm bead of form-in-place gasket to the oil pump case at the positions shown in the illustration.

Specified sealant:
Mitsubishi Genuine Part No. 970389 or equivalent

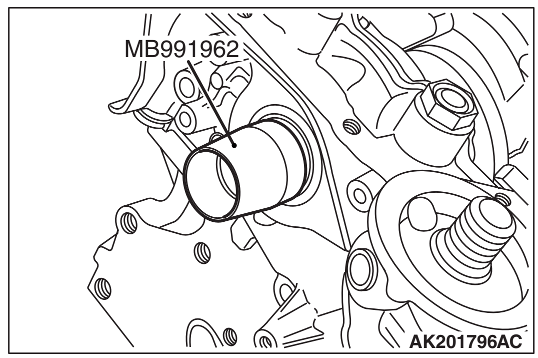


⚠ **CAUTION**

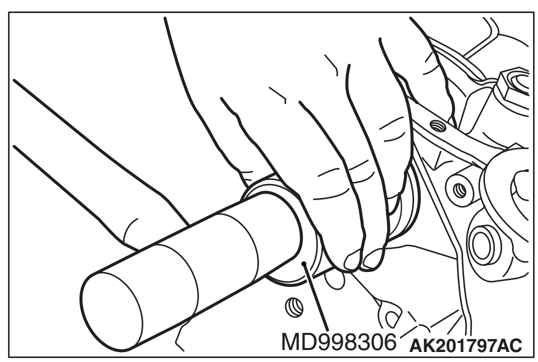
The mounting bolts are different in length. Take care not to use wrong bolts in wrong places.

3. Install the oil pump case to the cylinder head, and tighten mounting bolts to a specified torque of 14 ± 1 N·m.

>>B<< FRONT OIL SEAL INSTALLATION

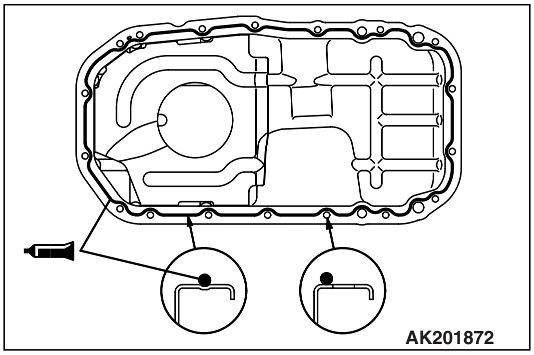


1. Place the special tool Crankshaft front oil seal guide (MB991962) on the crankshaft's front end and apply engine oil to the its outer circumference.



2. Apply engine oil to the oil seal lip, then push the oil seal along the guide by hand until it touches the front case. Tap the oil seal into place using the special tool Camshaft oil seal installer (MD998306).

>>C<< OIL PAN INSTALLATION

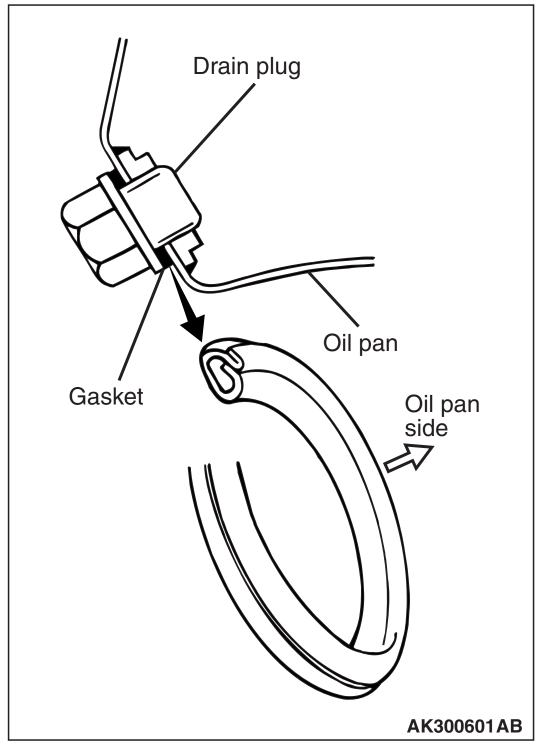


1. Completely remove existing form-in-place gasket from the cylinder block (oil pan mounting surface) and oil pan.
2. Apply a 4 ± 1mm bead of form-in-place gasket to the oil pan at the positions shown in the illustration.

   Specified sealant:
   Mitsubishi Genuine Part No. 970389 or equivalent

3. Install the oil pan to the cylinder block and tighten the tightening bolt to the specified torque of 7.0 ± 1.0 N·m.

>>D<< DRAIN PLUG GASKET INSTALLATION

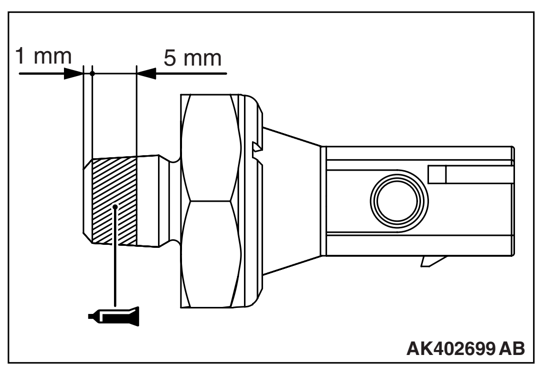


⚠ CAUTION

Installing the gasket with the wrong side facing the oil pan will result in oil leakage.

Replace the drain plug gasket with a new one. Install it with the side indicated in the illustration toward the oil pan.

>>E<< OIL PRESSURE SWITCH INSTALLATION



⚠ CAUTION

The threaded part tip of the switch must be clear of the sealant.

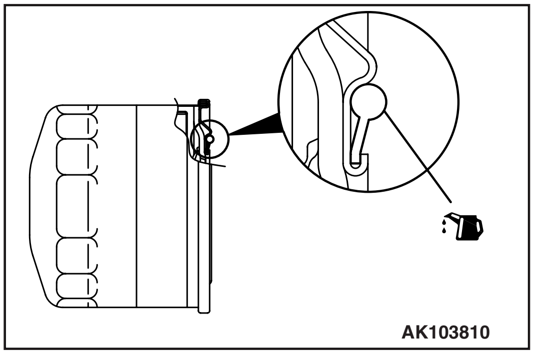
1. Completely remove existing sealant from the oil pressure switch and the switch mounting hole on the oil pump case.

2. Apply specified sealant to the threaded part of the oil pressure switch as shown.

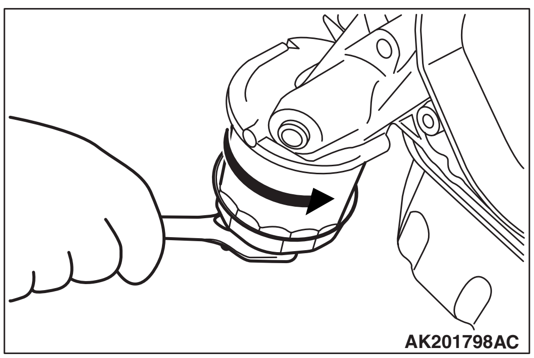
   Specified sealant:
   LOCTITE 565 or equivalent

3. Install the oil pressure switch to the oil pump case by tightening to a specified torque of 10 ± 2 N·m.

>>F<< OIL FILTER INSTALLATION



1. Clean the filter mounting surface on the front case.
2. Apply engine oil to the O-ring of the oil filter.



⚠ CAUTION

If the filter is tightened by hand only, it will be insufficiently torqued, resulting in oil leaks.

3. Screw the oil filter in and tighten the oil filter to the specified torque using a commercially available filter wrench from where the O-ring has come into contact with the oil filter mounting surface.

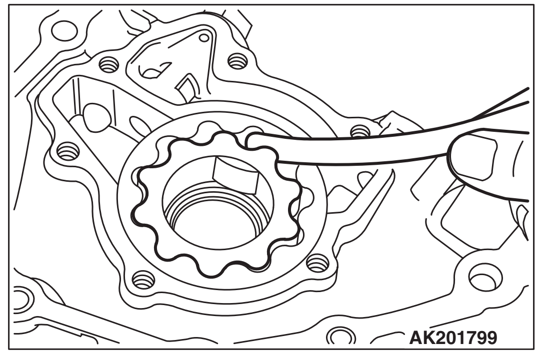
   Specified torque:
   MD348631, MD365876 16 ± 4 N·m (approx. 3/4 of a turn)
   MD360935 14 ± 2 N·m (approx. 1 turn)

INSPECTION

M1113008200502

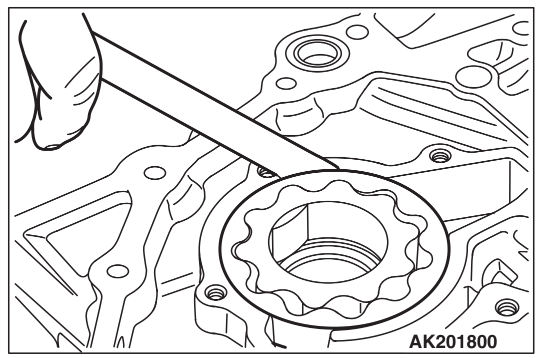
OIL PUMP

1. Fit the inner rotor and the outer rotor into the oil pump case.



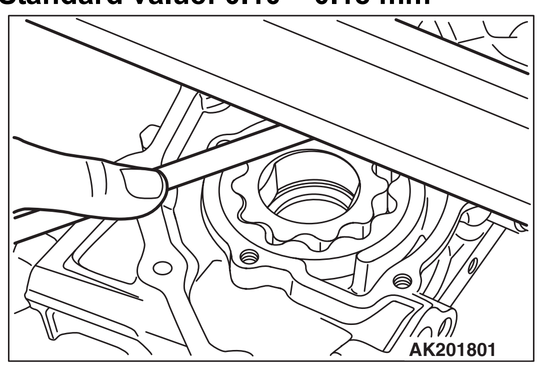
2. Check the tip clearance using a thickness gauge.

   Standard value: 0.06 – 0.18 mm



3. Check the side clearance using a straight edge and thickness gauge.

   Standard value: 0.10 – 0.18 mm



4. Check the body clearance using a thickness gauge.

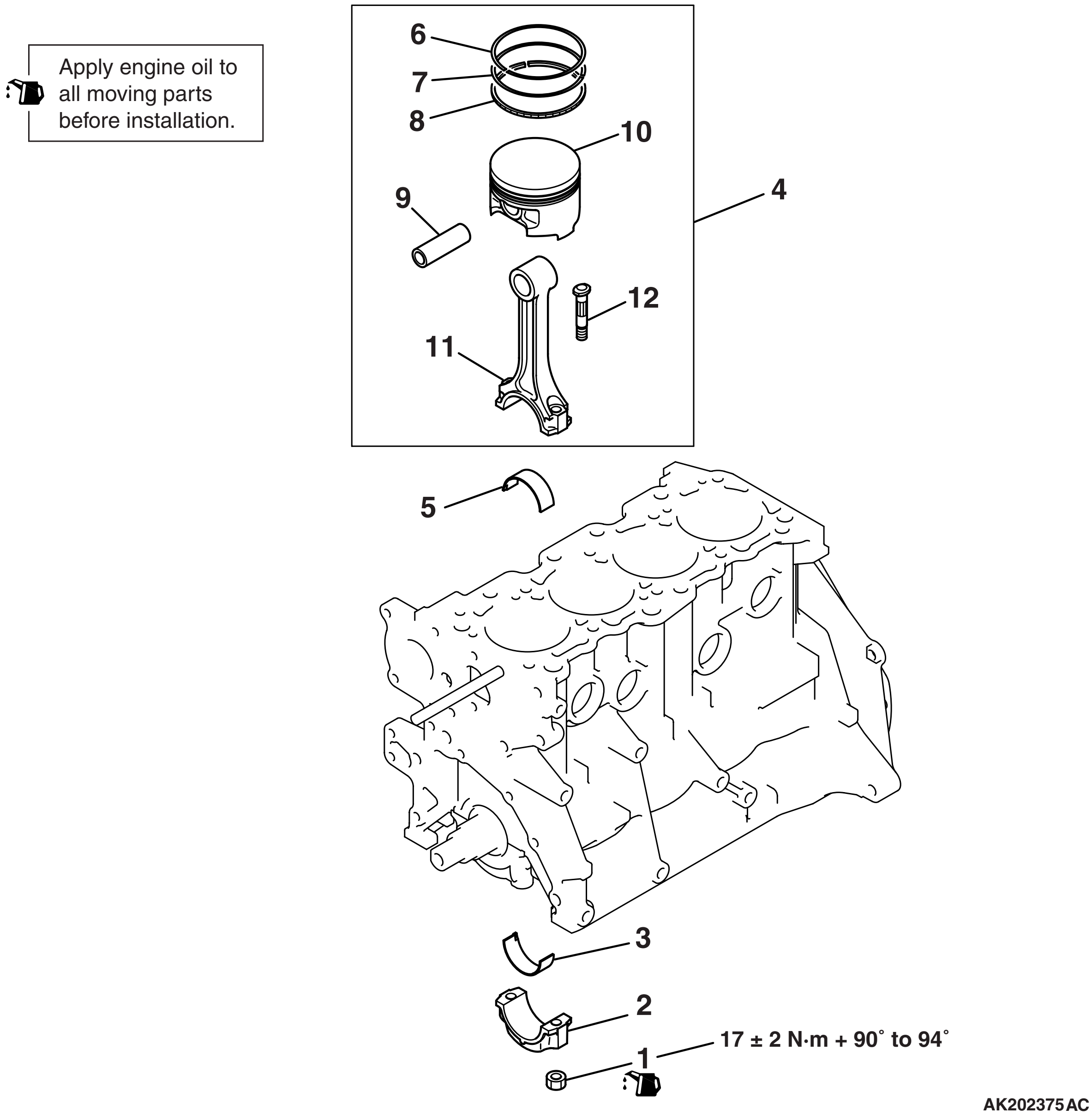
   Standard value: 0.040 – 0.095 mm

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PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008401123



Removal steps

- >>**G**<< 1. Connecting rod nut
- <<**A**>> >>**F**<< 2. Connecting rod cap
- >>**E**<< 3. Connecting rod bearing
- >>**D**<< 4. Piston and connecting rod assembly
- 5. Connecting rod bearing
- >>**C**<< 6. Piston ring No. 1
- >>**C**<< 7. Piston ring No. 2

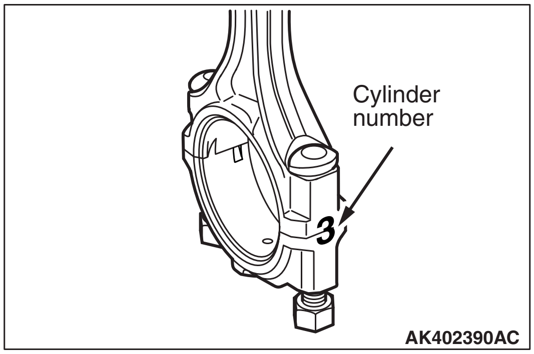
Removal steps (Continued)

- >>**B**<< 8. Oil ring
- <<**B**>> >>**A**<< 9. Piston pin
- 10. Piston
- 11. Connecting rod
- 12. Bolt

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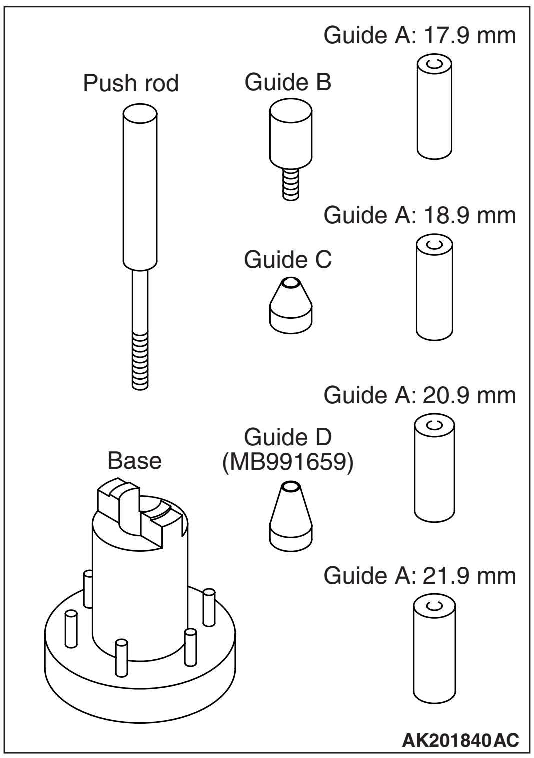
REMOVAL SERVICE POINTS

<<A>> CONNECTING ROD CAP REMOVAL

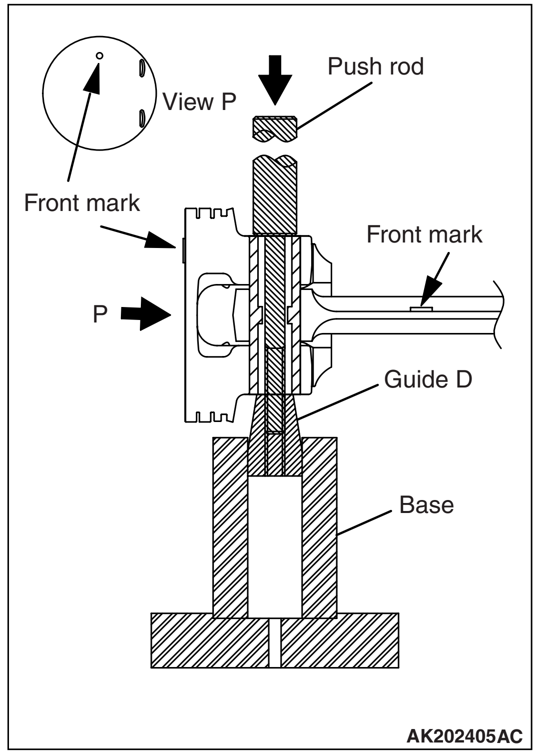


Mark the cylinder number on the side of the connecting rod big end as a guide for reassembly.

<<B>> PISTON PIN REMOVAL



1. The special tool Piston pin setting tool (MD998780) consists of the elements shown in the illustration.
2. When removing the piston pin, the special tool Guide D (MB991659) is also used.

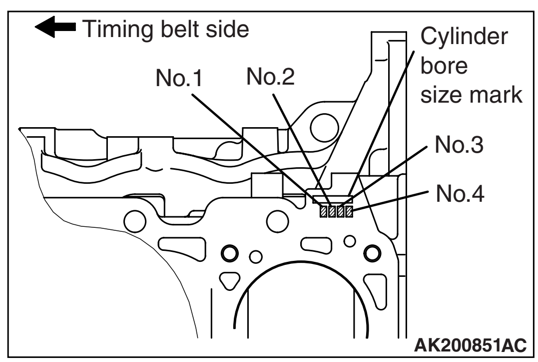


3. Insert Push rod, into the piston from the front mark side, then attach Guide D, to the push rod.
4. Place the piston and connecting rod assembly on Base, with the front mark facing up.
5. Use a press to remove the piston pin.

   NOTE: Keep the disassembled pistons, piston pins and connecting rods per cylinder.

INSTALLATION SERVICE POINTS

>>A<< PISTON PIN INSTALLATION



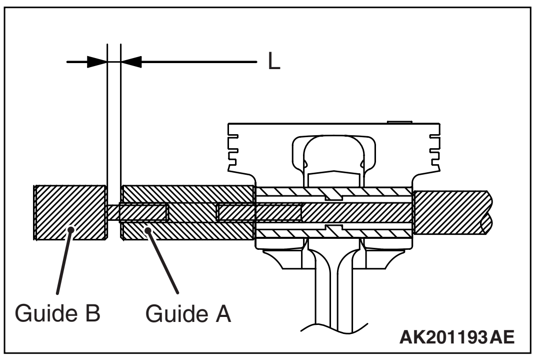
1. When replacing a piston, check the cylinder bore size mark stamped at the indicated location on the cylinder block and select an appropriate replacement piston using the following table.

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Cylinder bore size mark	Piston size mark
A	A
B	None
C	C

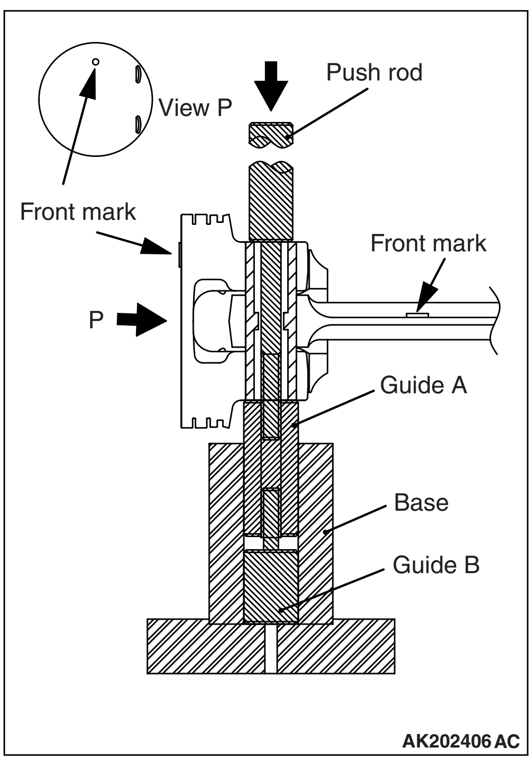
NOTE: The piston size mark is located on the piston top surface.

2. Insert the push rod into the piston pin and install the guide "A."
3. Align the front mark of the piston with that of the connecting rod. Align the piston with the connecting rod.
4. Apply engine oil to the outer circumference of the piston pin.
5. Insert the piston pin guide "A" installed at Step 2 into the pin hole from the front mark of the piston.



AK201193AE

6. Screw the guide "B" into "A" until the clearance "L" reaches 2.25mm between "A" and "B."



AK202406AC

7. Place the piston and connecting rod assembly onto Base, with the front marks facing up.
8. Install the piston pin using a press. If the required press force is less than the standard value, replace the piston and piston pin assembly or the connecting rod, or both.

   Standard value: 4,900 – 14,700 N

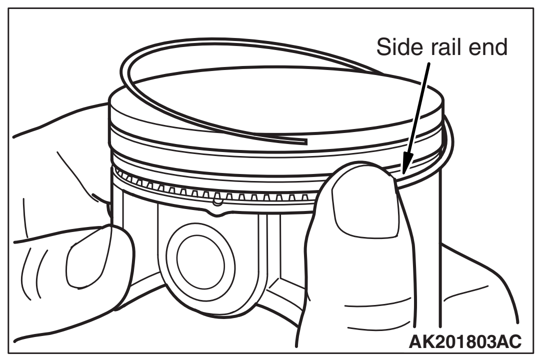
>>B<< OIL RING INSTALLATION

1. Fit the oil ring spacer into the piston ring groove.

   Install the upper side rail, then the lower side rail.

   NOTE: New spacers and side rails are an identified by color marks as follows:

Size	Color mark
Standard	No mark
0.50 mm oversize	Blue
1.00 mm oversize	Yellow

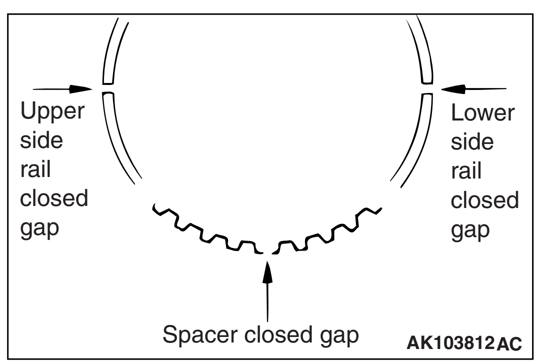


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⚠ CAUTION

Use of ring expander to expand the side rail end gap can break the side rail, unlike other piston rings.

2. To install each side rail, first fit one end of the rail into the piston groove, then press the remaining portion progressively into position by finger as shown in the illustration.
3. Make sure that the installed side rails move smoothly in either direction.

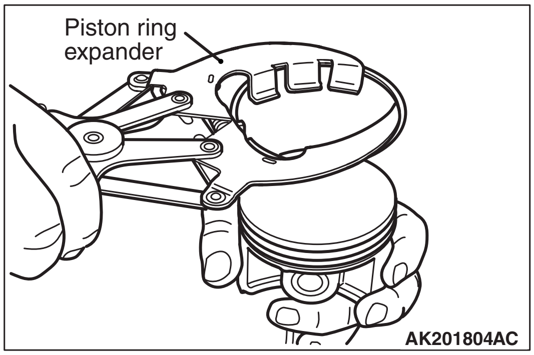


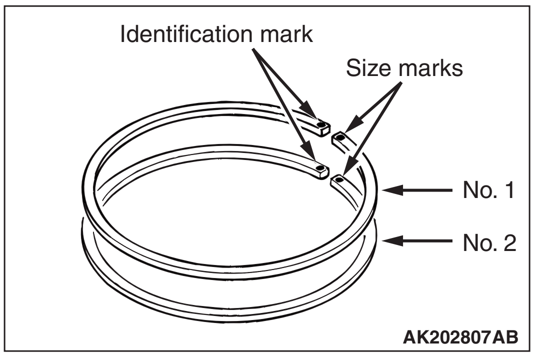
AK103812AC

4. Locate the side rail and spacer end gaps as shown in the illustration.

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>>C<< PISTON RING NO. 2/PISTON RING NO. 1 INSTALLATION





Using a piston ring expander, install the piston rings with their identification marks facing up (toward the piston crown).

Identification marks:

No. 1 ring 1R

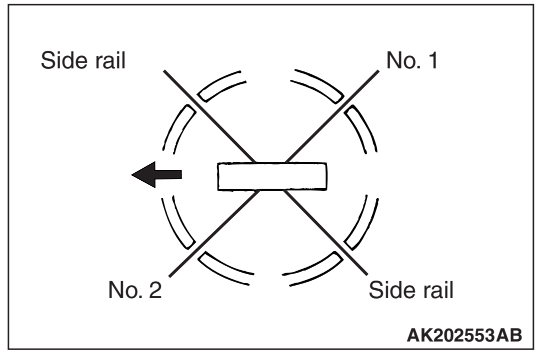
No. 2 ring 2R

NOTE: . Each of the available piston rings has a size mark as follows:

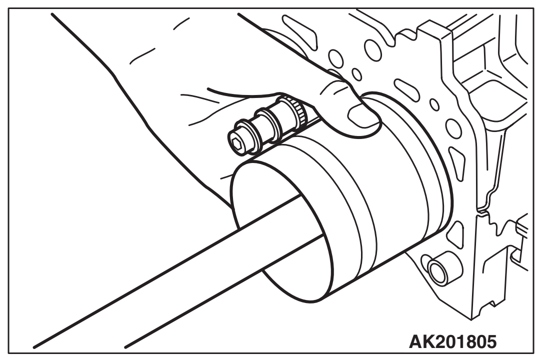
Size	Size mark
Standard	No mark
0.50 mm oversize	50
1.00 mm oversize	100

>>D<< PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

1. Apply engine oil generously to the piston's outside surface, piston rings, and oil ring.

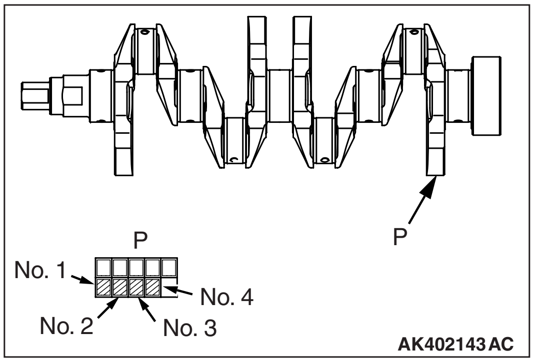


2. Align the end gaps of the piston rings and oil ring (side rails and spacer) as shown in the illustration.
3. Insert the piston and connecting rod assembly from the top of cylinder with the front mark on the crown toward the timing belt side.



4. Use a piston ring band to hold the piston rings compressed when inserting the piston and connecting rod assembly into the cylinder.

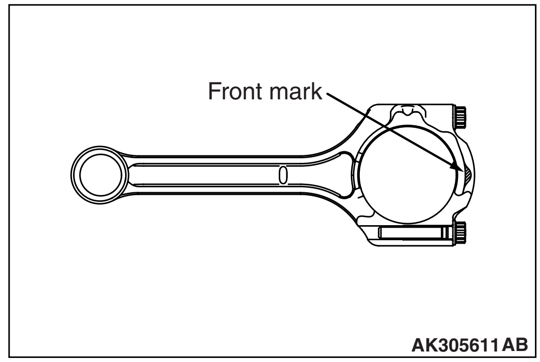
>>E<< CONNECTING ROD BEARING INSTALLATION



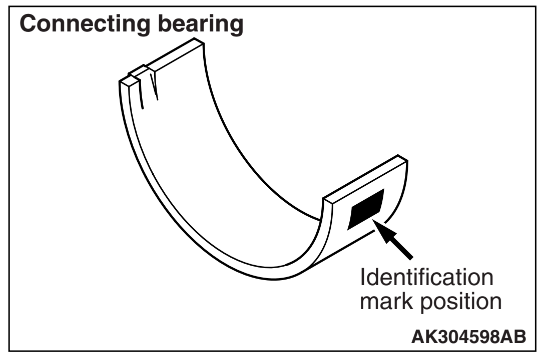
1. When replacing the connecting rod bearing, select a bearing of the size appropriate for the crankshaft pin diameter in accordance with the crankshaft pin and connecting rod bearing matching table shown below.

Bearing Selection Table

Crankshaft		**Connecting rod Identification mark**	**Bearing identification mark**
Identification mark	**Pin diameter mm**		
A or I	41.994 – 42.000	A	0
		None	1
		C	2
B or II	41.988 – 41.994	A	1
		None	2
		C	3
C or III	41.982 – 41.988	A	2
		None	3
		C	4



2. The identification mark of the connecting rod is found in the position shown in the illustration.



3. Select bearings from the bearing selection table in accordance with the identification marks and color codes checked at steps 1 and 2 above.

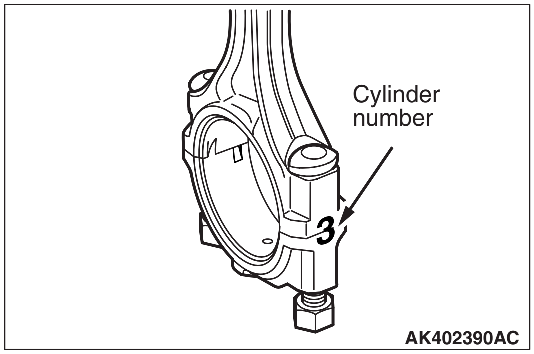
   <Bearing selection example>

   (1) If the measured outside diameter of crankshaft pin is 42.000 mm, the identification mark are "A" and I, respectively.

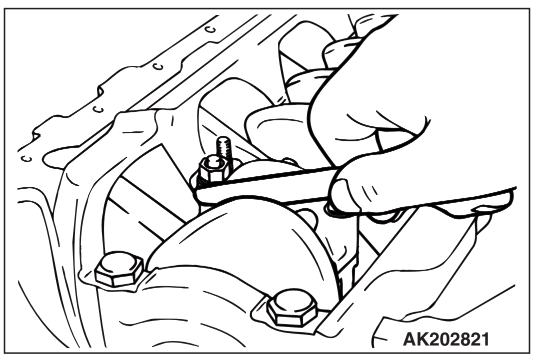
   (2) Based on the above, if the identification of the connecting rod is "A," select the bearing marked in I.

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>>F<< CONNECTING ROD CAP INSTALLATION



1. Install the bearing cap on the connecting rod while aligning the marks made during disassembly. If the connecting rod is new and has no alignment mark, assemble it with the cap such that the both bearing locating notches are on the same side as shown in the illustration.

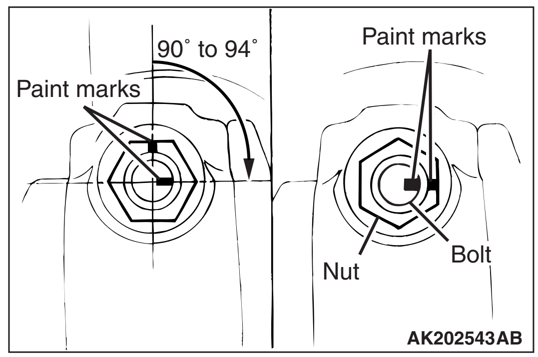


2. Make sure that the thrust clearance of the connecting rod big end is proper.

   Standard value: 0.10 – 0.25 mm
   Limit: 0.4 mm

>>G<< CONNECTING ROD CAP NUT INSTALLATION

1. The connecting rod cap bolts and nuts are tightened using the torque-to-yield method. For this reason, each bolt to be reused must be checked for elongation before installation. Whether or not the bolt has been elongated can be determined by running a nut with fingers through all the threads of the bolt. If the nut does not turn smoothly over all the threads, the bolt has been elongated and must be replaced.
2. Apply engine oil to the threads and bearing surface of each nut before installation.
3. Finger-tighten the nuts on the bolts, then tighten the nuts alternately and repeatedly to install the cap properly.
4. Tighten the nuts to a torque of 17 ± 2 N·m.



5. Make a paint mark on the head of each nut.
6. Make a paint mark on the bolt at a point 90° to 94° away from the paint mark made on the nut in the tightening direction.

⚠ CAUTION

- **If the tightening angle is less than 90°, adequate tightness could not be assured.**
- **If the tightening angle exceeds 94°, loosen the nut completely and then perform the tightening procedure again beginning with the first step.**

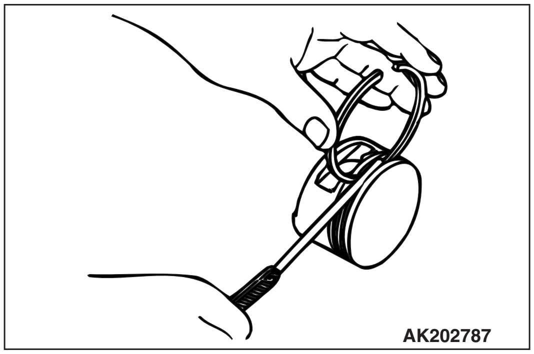
7. Turn the nut 90° to 94° to bring the mark on the nut into alignment with that on the bolt.

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INSPECTION

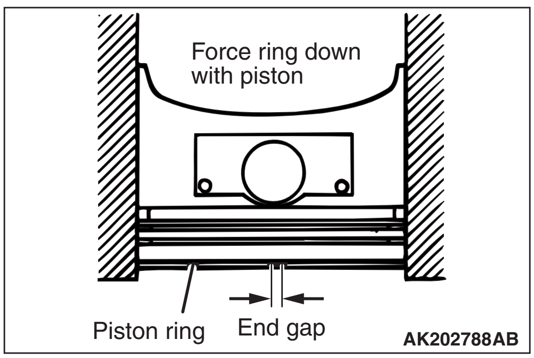
M1113008500848

PISTON RING



1. Measure the clearance between each piston ring and its groove. If the limit is exceeded, replace the ring or piston, or both.

 Standard values:
 No. 1 ring 0.03 – 0.07 mm
 No. 2 ring 0.02 – 0.06 mm



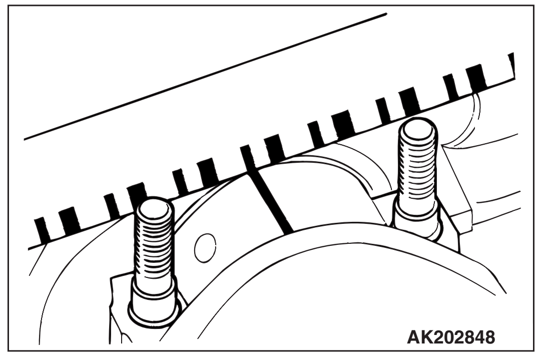
2. Install the piston ring into the cylinder bore and force it down with the head of the piston until the ring becomes right-angled to the cylinder wall. Then, measure the end gap of the ring with a thickness gauge. If the end gap is excessive, replace the piston ring.

 Standard values:
 No. 1 ring 0.15 – 0.30 mm
 No. 2 ring 0.30 – 0.45 mm
 Oil ring 0.20 – 0.50 mm

 Limits:
 No. 1 ring 0.8 mm
 No. 2 ring 0.8 mm
 Oil ring 1.0 mm

CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGE METHOD)

1. Wipe off oil from the crankshaft pin and connecting rod bearing.
2. Cut a piece of plastic gauge whose length is equivalent to the width of the bearing and place it on the crankshaft pin in parallel with its axis.
3. Install the connecting rod cap carefully and tighten the nuts according to INSTALLATION SERVICE POINTS >>G<< P.11D-43 .
4. Remove the nuts, then remove the connecting rod cap carefully.



5. Measure the largest width of the crushed plastic gauge using the ruler printed on the bag of the plastic gauge.

 Standard value: 0.025 – 0.040 mm

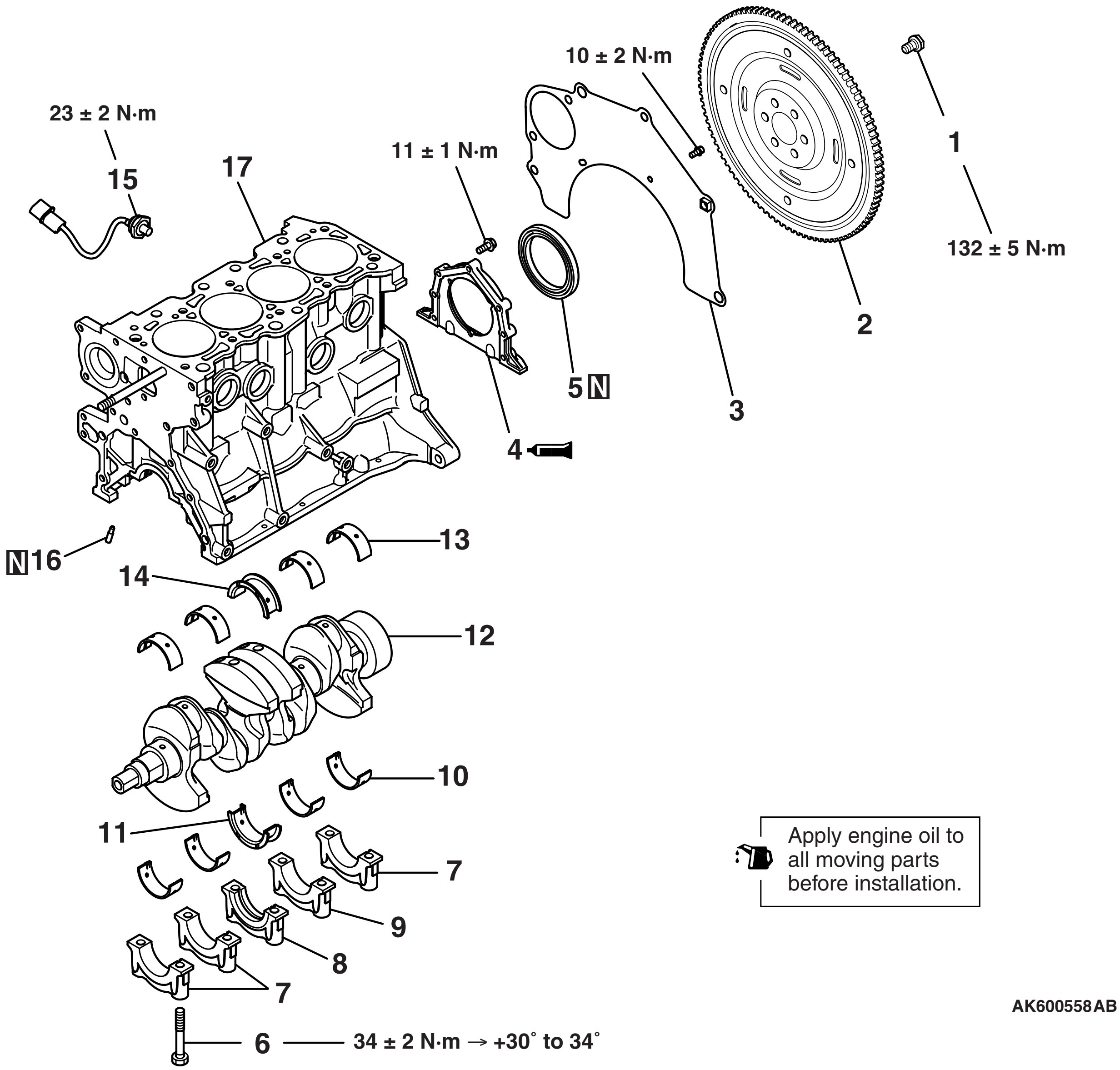
 Limit: 0.1 mm

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CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008701793



Removal steps

<<A>> >>F<< 1. Flywheel bolt
2. Flywheel
3. Rear plate
>>E<< 4. Rear oil seal case
>>D<< 5. Rear oil seal
>>C<< 6. Bearing cap bolt
>>C<< 7. Bearing cap
>>C<< 8. Bearing cap center
>>C<< 9. Bearing cap No.4
>>B<< 10. Crankshaft bearing, lower

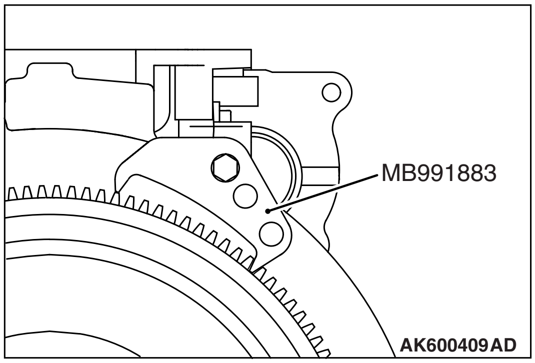
Removal steps (Continued)

>>B<< 11. Crankshaft bearing, center
12. Crankshaft
>>B<< 13. Crankshaft bearing, upper
>>B<< 14. Crankshaft bearing, center
15. Detonation sensor
<<B>> >>A<< 16. Oil jet
17. Cylinder block

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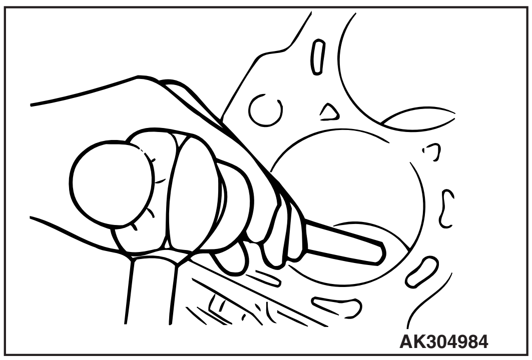
REMOVAL SERVICE POINTS

<<A>> DRIVE PLATE BOLT REMOVAL



1. Using the special tool Flywheel stopper (MB991883), hold the flywheel in place.
2. Remove the flywheel bolts.

<<B>> OIL JET REMOVAL

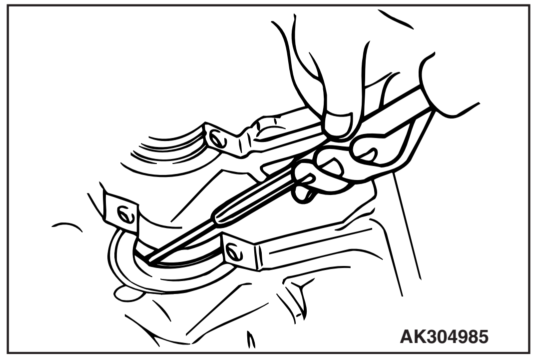


⚠ CAUTION

Pay full attention not to damage the cylinder wall. Using the metallic bar of the appropriate length, strike to the oil jet.

INSTALLATION SERVICE POINTS

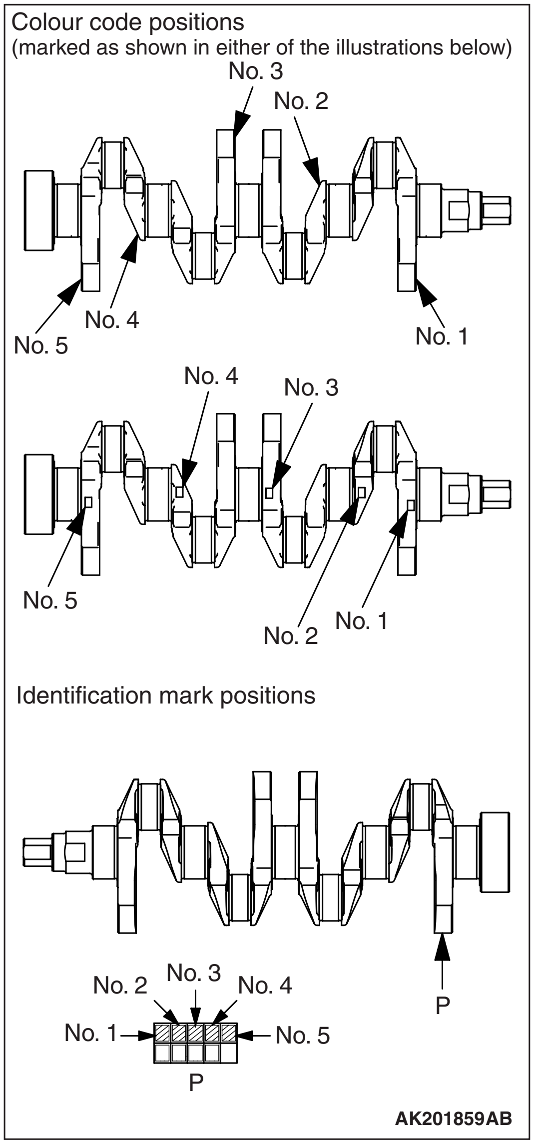
>>A<< OIL JET INSTALLATION



Until reaching the bottom, strike the oil jet from the crankshaft journal using the pin punch whose diameter is 4.5mm.

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>>B<< CRANKSHAFT BEARING INSTALLATION



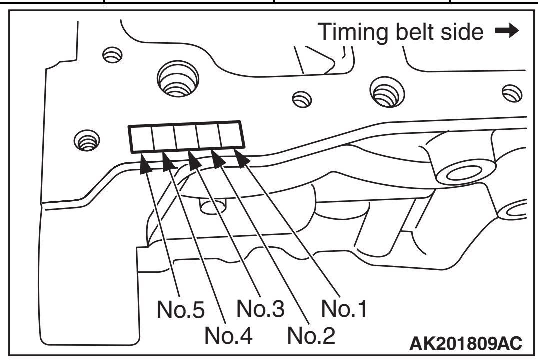
1. Measure the crankshaft journal diameter and select bearings according to identification marks or color codes given in the table below. The journal diameter can be identified if the crankshaft is provided with identification markings in the illustrated positions.

Bearing Selection Table

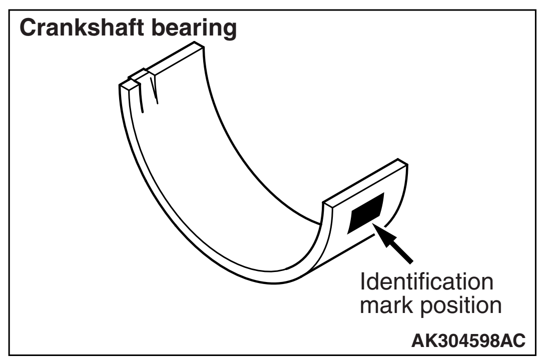
Crankshaft: Identification color or mark	Crankshaft: Journal diameter mm	Cylinder block identification mark	Bearing identification mark
Yellow or 1	47.994 – 48.000	0	1
		1	2
		2	3

Bearing Selection Table

Crankshaft: Identification color or mark	Crankshaft: Journal diameter mm	Cylinder block identification mark	Bearing identification mark
No color or 2	47.988 – 47.994	0	2
		1	3
		2	4
White or 3	47.982 – 47.988	0	3
		1	4
		2	5



2. Cylinder block bearing bore diameter identification marks are stamped in the positions shown, starting with No. 1 from the timing belt side.



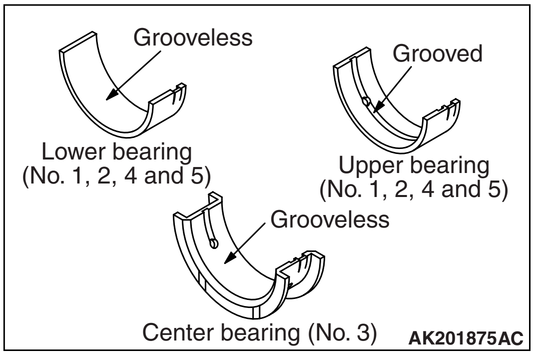
3. Based on the identifiers verified in steps 1 and 2, select bearings from the table above.

   <Bearing selection example>

   (1) If measured crankshaft journal diameter is 48.000mm, it means yellow in crankshaft color code or 1 in crankshaft identification mark.

   (2) Based on the above, if the cylinder block bearing bore diameter identification mark is 1, select a bearing with an identification mark of 2.

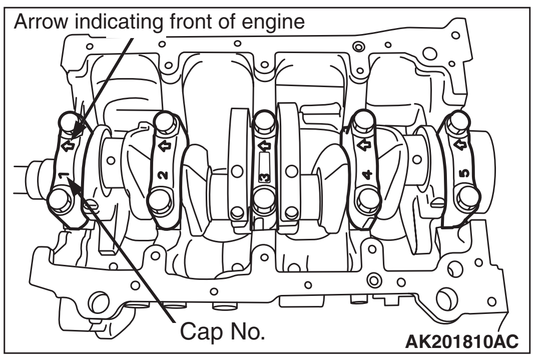
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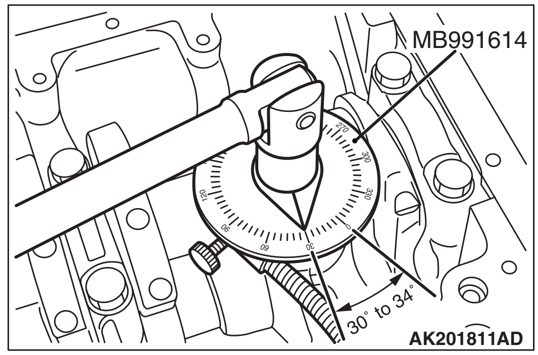
4. Install grooved bearings to the cylinder block.

   NOTE: Center bearings (with thrust flanges) are grooveless.
5. Install grooveless bearings to the bearing caps.

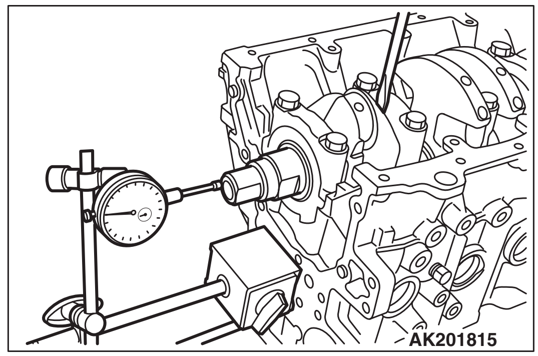
>>C<< BEARING CAP/BEARING CAP CENTER/BEARING CAP NO.4 INSTALLATION



1. On the bottom surface of each bearing cap is the cap's number and an arrow. Starting at the timing belt side, fit the bearing caps in numerical order. Ensure that the arrows point toward the timing belt side.
2. Apply engine oil to the threaded portion and bearing surface of the bolt.
3. Tighten the bolts to the specified torque of 34 ± 2 N·m.



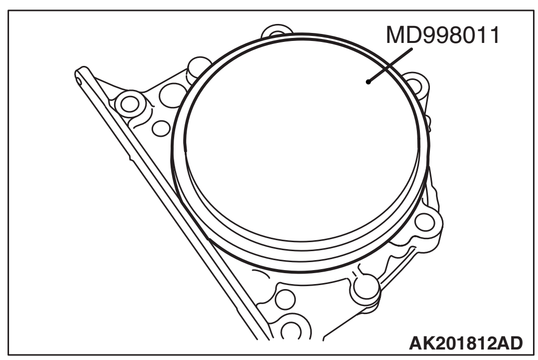
4. Using the special tool Angle sensor (MB991614), tighten the bolts to a further 30° to 34°.



5. After fitting the bearing caps, measure the end play in the crankshaft. If the measurement exceeds the specified limit, replace the crankshaft bearings.

   Standard value: 0.05 – 0.18 mm
   Limit: 0.25 mm

>>D<< REAR OIL SEAL INSTALLATION

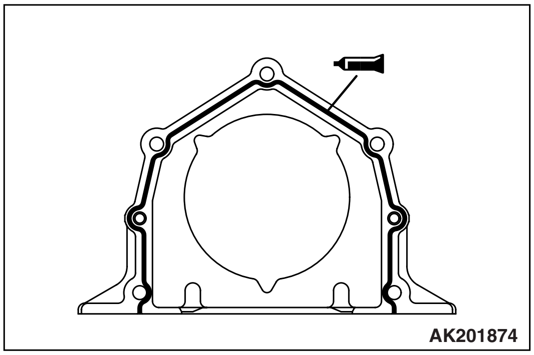


Press-fit the rear oil seal using the special tool Crankshaft rear oil seal installer plate (MD998011).

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>>E<< REAR OIL SEAL CASE INSTALLATION

1. Remove completely old FIPG remaining on the rear oil seal case and cylinder block (oil seal case mounting surface).

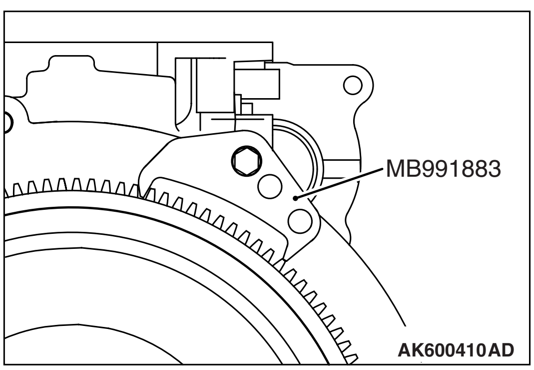


2. Apply a bead of FIPG to the surface of the rear oil seal case as shown in the illustration.

    Specified sealant:
    Mitsubishi Genuine Part No. 970389 or equivalent

3. Install the oil seal into the cylinder block after applying an appropriate amount of engine oil to the entire circumference of its lip portion.
4. Install the rear oil seal case by tightening its bolts to 11 ± 1 N·m.

>>F<< DRIVE PLATE BOLT INSTALLATION



1. Using the special tool Flywheel stopper (MD998781) secure the flywheel.
2. Tighten the flywheel bolt to the specified torque of 132 ± 5 N·m.

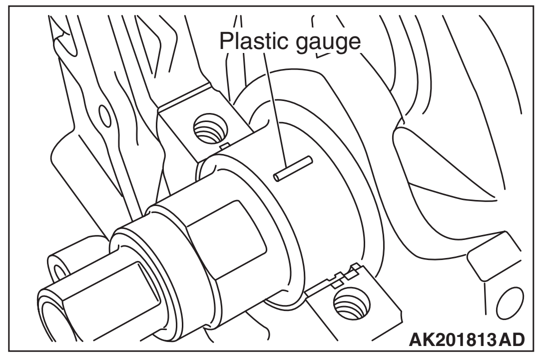
INSPECTION

M1113008800850

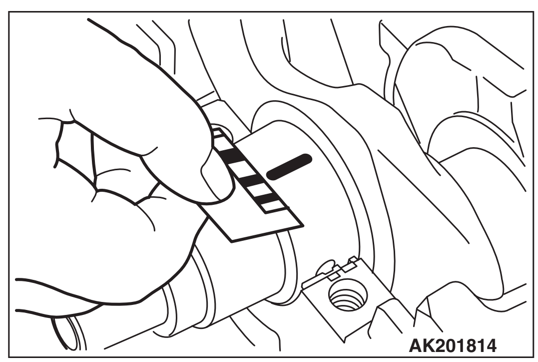
CRANKSHAFT OIL CLEARANCE (PLASTIC GAUGE METHOD)

This plastic gauge method is recommended as the simplest way of measuring the crankshaft oil clearance.
Measure the crankshaft oil clearance using a plastic gauge as follows:

1. Wipe off oil from the crankshaft journal surface and the crankshaft bearing inner surface.
2. Install the crankshaft.



3. Cut a piece of plastic gauge whose length is equivalent to the width of the bearing and place it on the crankshaft journal in parallel with its axis.
4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque according to INSTALLATION SERVICE POINTS >>B<<P.11D-50.
5. Remove the bolts, then remove the crankshaft bearing cap carefully.



6. Measure the largest width of the crushed plastic gauge using the ruler printed on the bag of the plastic gauge.

    Standard value: 0.02 – 0.04 mm
    Limit: 0.1 mm

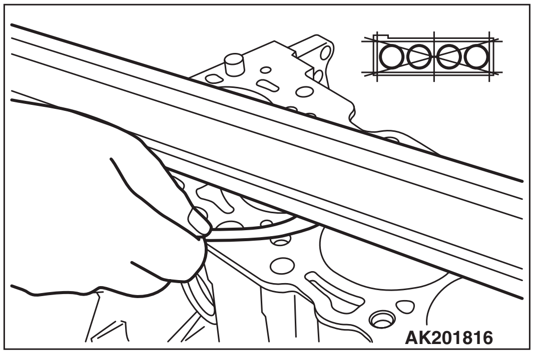
    NOTE: The crankshaft pins and journals are fillet-rolled and must not be machined to undersize dimensions.

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CYLINDER BLOCK

1. Visually check the cylinder block for scratches, rust, and any other corrosion. Also check it for cracks using a flaw detecting penetrant.

   If any defect is evident, replace the cylinder block.



2. Use a straightedge and thickness gauge to check the cylinder block top surface for warp.

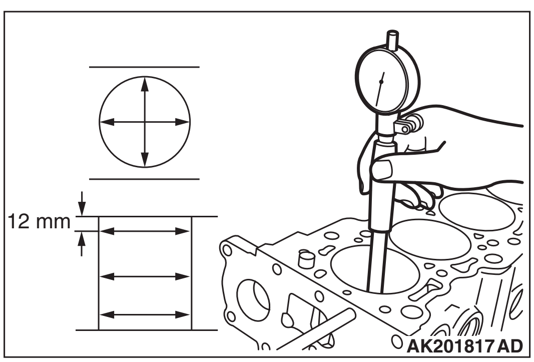
   If the warp exceeds the specified limit, correct by grinding.

   Make sure that the surface is free from remaining gasket material and other foreign matter.

   Standard value: 0.05 mm
   Limit: 0.1 mm
   Grinding limit: 0.2 mm

3. Check cylinder walls for scratches and seizure.

   If defects are evident, rebore to oversize or replace the cylinder block.



4. Use a cylinder gauge to measure the cylinder bore diameter and taper.

   If the cylinder is worn badly, rebore it to an oversize and replace the piston and piston rings with ones matched with the new bore size.

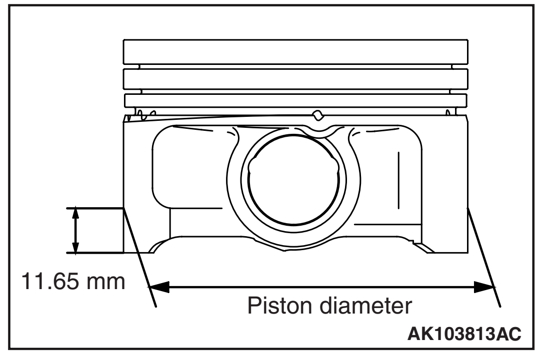
   The points at which the measurements should be made are indicated in the illustration.

   Standard value: 75.50 – 75.53 mm

   Taper: 0.01 mm or less

BORING CYLINDERS

1. Select an oversize of the pistons to be used based on the largest of the cylinder bores.



2. Oversize pistons are available in two oversizes: 0.50 mm and 1.00 mm. Bore each cylinder to a size that provides the standard clearance when combined with the selected piston. The reference position for piston diameter measurement is as shown in the illustration.
3. Based on the piston diameter measurement, calculate the boring finish dimension.
   - Boring finish dimension = [Piston diameter] + [0.02 – 0.04 mm (clearance between piston and cylinder)] – [0.02 mm (honing margin)]

⚠ CAUTION

To prevent deformation of cylinder block that would result from the heat generated by boring, bore the cylinders in the following sequence: No. 2 → No. 4 → No. 1 → No. 3.

4. Bore all the cylinders to the calculated boring finish dimension.
5. Hone the bored cylinders to the final finish dimension (piston diameter + clearance between piston and cylinder).
6. Check the clearance between the piston and cylinder.

   Standard value: 0.02 – 0.04 mm